SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JUNE 1911.

CONTENTS.

GENERAL PHYSICS.

PAGE
717. Refractometer for determining Salinity of Sea-water. *A. Berget* 257
718. Measurements of End-standards of Length. *P. E. Shaw* 257
719. Friction. *F. Charron* 258
720. Formulæ for Shearing Deflection of Beams. *S. E. Slocum* 258
721. Method of Calibrating Capillary Tubes. *T. R. Merton* 258
722. Flow of Gas in Capillary Tubes. *W. J. Fisher* 259
723. A Method of observing Stream-lines in Air. *A. Lafay* 259
724. Measurement of Wind Velocity. *A. Lafay* 259
725. Pitot Constant. *J. D. Fry & A. M. Tyndall* 260
726. Movement of Coloured Index along Capillary Tube. *A. Griffiths* 260
727. Flow of Thin Liquid Films. *W. G. Royal-Dawson* 261
728. Uniform Rotation on Relativity Principle. *H. Donaldson & G. Stead* 261
729. Uniform Rotation and Relativity Principle. *W. F. G. Swann* 261
730. Kinetic Theory of Gases. *L. Dunoyer* 261
731. Angular Rotation of Solar Prominence. *J. Evershed* 262
732. Motions of the Solar Atmosphere. *H. Deslandres* 263
733. Structure of the Solar Corona. *C. Störmer* 263
734. Observations of Prominences. *G. Abetti & R. E. Smith* 263
735. Pyrheliometric Scale for Solar Radiation. *C. G. Abbot & L. B. Aldrich* ... 263
736. Circulation in the Solar Atmosphere. *F. Slocum* 264
737. Selective Reflection of the Moon's Surface. *A. Miethe & B. Seegert* 264
738. Satellites of Mars. *P. Lowell* 264
739. Periodic Times of Saturn's Rings. *H. Wilde* 264
740. Nova Lacertæ. *M. Wolf, E. E. Barnard, Münch, Eberhard, E. C. Pickering, & P. Idrac* 265

PAGE
741. Spectrum of Halley's Comet. *C. P. Butler* 265
742. Sequence of Chemical Forms in Stellar Genera. *N. Lockyer* 266
743. Determinations of Stellar Parallax. *F. Schlesinger* 267
744. Determination of Stellar Spectral Types. *S. Albrecht* 267
745. Spectrum of *o* Persei. *F. C. Jordan* 267
746. Radiation producing Aurora Borealis. *L. Vegard* 267
747. Zodiacal Light. *Birkeland* 268
748–750. References 268

LIGHT.

751. Reflection of Ultra-violet Rays by Snow. *J. v. Kowalski* 269
752. Oscillatory Interference Bands. *G. O. Squier & A. C. Crehore* 269
753. Formula for Optical Instruments. *A. S. Hawkesworth* 269
754. Crova's Method of Heterochromatic Photometry. *H. E. Ives* 269
755. Photographic Irradiation. *C. E. K. Mees* 270
756. Photographic Reproduction of Documents. *G. de Fontenay* 270
757. Sensibility of Eye to Variations of Wave-length. *Rayleigh* 270
758. Selective Absorption of Light. *W. H. Julius* 271
759. Intensity Distribution in Spectral Lines. *P. P. Koch & A. E. Weber* 271
760–768. References 272

HEAT.

769. Temperature Scale between 100° and 500° C. *C. W. Waidner & G. K. Burgess* 273
770. Emissive Power of Wedge-shaped Cavities. *C. E. Mendenhall* 273
771. Lummer-Pringsheim Photometer as Pyrometer. *E. Thürmel* 273
772. Further Experiments with Liquid Helium. *H. Kamerlingh Onnes* 274
773. Isotherms of Monatomic Substances. IX. Argon. *H. Kamerlingh Onnes & C. A. Crommelin* 274

ELECTRICITY AND MAGNETISM.

774. Definition of Intensity of Electric Current. *A. Occhialini* 275
775. Electric Dust Figures. *J. Robinson* 275
776. Mobility of Ions from Quinine Sulphate. *M. de Broglie & L. Brizard* 275
777. Behaviour of Hydrogen Flame in Chlorine. *J. Franck & P. Pringsheim* 275
778. Photo-electric Effects in Alkali Metals. *R. Pohl & P. Pringsheim* 276
779. Photo-electric Sensitivity of Metals. *H. Dember* 276
780. Actino-dielectric Action with Alkaline Earths. *C. Ramsauer & W. Hausser* 276
781. Speed of Electric Waves along Wires. *C. Gutton* 277
782. Slightly Damped Electrical Oscillations. *K. Settnik* 277
783. Tests of Insulators at High Temperatures. *W. W. Stifler* 277
784. Electro-capillarity. *G. v. Hevesy & R. Lorenz* 277
785. Determining Capacities in Ionisation Measurements. *N. Campbell* 278
786. Range of Power in Mirror Reading. *W. Volkmann* 278
787. Iron and its Alloys in Intense Fields. *R. A. Hadfield & B. Hopkinson* 278

PAGE
788. Mechanical Stress and Magnetisation of Nickel. *W. Brown* 279
789. Magnetisation of Iron in very Low Fields. *W. Kummer*.......................... 280
790. Joule- and Wiedemann-effects in Steel Tubes. *S. R. Williams* 280
791. Magnéton in Solid Paramagnetic Substances. *P. Weiss* 280
792. Propagation of Magnetic Waves in an Iron Bar. *C. V. Drysdale* 280
793. Magnetism of some Complex Salts. *Mlle. E. Feytis* 281
794. Magneto-chemical Researches on Halogens. *P. Pascal* 281
795. Earth Currents and Magnetic Disturbances. *J. Bosler*............................. 281
796. Time Accuracy in Magnetic Registration. *G. van Dijk* 281
797. Measurement of Magnetic Susceptibility. *C. E. Mendenhall & W. F. Lent* 282
798–799. References 282

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

800. Behaviour of Solid and Liquid Copper towards Gases. *A. Sieverts & W. Krumbhaar* 283
801. Influence of Manganese on Mild Steel. *G. Lang*.. 283
802. Internal Structure of Pearlitic Steel. *M. Oknof* 283
803. The Ovifaker Iron. A Natural Carbon Steel. *C. Benedicks* 284
804. Action of U.V. Rays on Cyclic Compounds. *D. Berthelot & H. Gaudechon* 284
805. Relation of Osmotic Pressure to Temperature. *H. N. Morse, W. W. Holland, J. C. W. Fraser, B. Mears, J. L. Carpenter* 284
806. Boiling-point at Diminished Pressures. *K. Drucker* 284
807. Remark on the Law of Eötvös. *A. Einstein* 285
808. Effects of Ultra-violet Radiations. *A. Guntz & J. Minguin* 285
809. Adsorption of Solutions. *G. C. Schmidt* 285
810. Ozone Formation by the Silent Discharge. *A. W. Ewell* 286
811. New Proof of Existence of Molecules. *T. Svedberg & N. Pihlblad* 286
812. Precipitation of Metals at High Pressures. *W. N. Ipatiev & W. Werchowskij* 286
813. Binary Equilibrium Diagrams. *K. Bornemann* 287
814. Electrolytic Conductivity of Non-aqueous Solutions. *P. Walden* 287
815. Theory of the Opalescence of Homogeneous Liquids. *A. Einstein* 288
816. Electrolytic Method for determining Metals. *W. L. Perdue & G. A. Hulett*... 288
817. Electrolytic Determination of Zinc in Ores. *G. Kemmerer* 288

AUTHORS' INDEX.

Abbot, C. G., 735.
Abetti, G., 734.
Albrecht, S., 744.
Aldis, A. C. W., 760.
Aldrich, L. B., 735.
Barnard, E. E., 740.
Benedicks, C., 808.
Berget, A., 717.
Berthelot, D., 804.
Birkeland, 747.
Bornemann, K., 813.
Bosler, J., 795.
Brizard, L., 776.
de Broglie, M., 776.
Brown, W., 788.
Burgess, G. K., 769.
Butler, C. P., 741.
Campbell, N., 785.
Carpenter, J. L., 805.
Charron, F., 719.
Crehore, A. C., 752.
Crommelin, C. A., 773.
Dawson-Royal, W. G., 727.
v. Dechend, H., 765.
Dember, H., 779.
Deslandres, H., 732.
van Dijk, G., 796.
Dobson, G. M. B., 760.
Donaldson, H., 728.
Drucker, K., 806.
Drysdale, C. V., 792.
Dunoyer, L., 730.
Eberhard, 740.
Einstein, A., 807, 815.
Evershed, J., 731.
Ewell, A. W., 810.
Feytis, Mlle. E., 793.
Fisher, W. J., 722.
de Fontenay, G., 756.
Franck, J., 777.
Frazer, J. C. W., 805.
Fry, J. D., 725.
Gaudechon, H., 804.
Griffiths, A., 726.
Guntz, A., 808.
Gutton, C., 781.
Hadfield, R. A., 787.
Hammer, W., 765.
Harting, H., 766.
Hausser, W., 780.
Hawkesworth, A. S., 753.
v. Hevesy, G., 784.
Holland, W. W., 805.
Hopkinson, B., 787.
Hulett, G. A., 816.
Idrac, P., 740.
Ipatiev, W. N., 812.
Ishiwara, J., 761.
Ives, H. E., 754.
Jones, H. J., 748.
Jordan, F. C., 745.
Julius, W. H., 758.
Kamerlingh Onnes, H., 772, 773.
Kayser, H., 768.
Kemmerer, G., 817.
Kleeman, R. D., 750.
Koch, P. P., 759.
v. Kowalski, J., 751.
Krumbhaar, W., 800.
Kummer, W., 789.
Lafay, A., 723, 724.
Lang, G., 801.
Leduc, A., 798.
Lent, W. F., 797.
Lockyer, N., 742.
Lorentz, H. A., 767.
Lorenz, R., 784.
Lowell, P., 738.
Mears, B., 805.
Mees, C. E. K., 755.
Mendenhall, C. E., 770, 797.
Merton, T. R., 721.
Miethe, A., 737.
Minguin, J., 808.
Morse, H. N., 805.
Münch, 740.
Occhialini, A., 774.
Oknof, M., 802.
Onnes, H. Kamerlingh, 772, 773.
Pascal, P., 794.
Perdue, W. L., 816.
Pickering, E. C., 740.
Pihlblad, N., 811.
Pohl, R., 778.
Prideaux, E. B. R., 816.
Pringsheim, P., 777, 778.
Ramsauer, C., 780.
Rayleigh, 749, 757.
Reinganum, M., 762.
Robinson, J., 775.
Royal-Dawson, W. G., 727.
Schlesinger, F., 743.
Schmidt, G. C., 809.
Schwietring, F., 764.
Searle, G. F. C., 760.
Seegert, B., 737.
Settnik, K., 782.
Shaw, P. E., 718.
Sieverts, A., 800.
Slocum, F., 736.
Slocum, S. E., 720.
Smith, R. E., 734.
Squier, G. O., 752.
Stead, G., 728.
Stifler, W. W., 783.
Störmer, C., 733.
Svedberg, T., 811.
Swann, W. F. G., 729.
Thürmel, E., 771.
Tyndall, A. M., 725.
Vegard, L., 746.
Voigt, W., 767, 799.
Volkmann, W., 786.
Waidner, C. W., 769.
Walden, P., 814.
Weber, A. E., 759.
Weiss, P., 791.
Werchowskij, W., 812.
Wilde, H., 739.
Williams, S. R., 790.
Wolf, M., 740.
Wright, F. E., 763.

SCIENCE ABSTRACTS.

Section A.—PHYSICS

JUNE 1911.

GENERAL PHYSICS.

717. *Refractometer for determining the Salinity of Sea-water.* **A. Berget.** (Comptes Rendus, 152. pp. 984–986, April 3, 1911.)—As the determination of the salinity from density measurement by means of areometers is hardly possible on board ship, total reflection refractometers of Pulfrich and of Abbe had been tried. The author finds a simplified Féry refractometer more convenient; the determination is rapid and a few cm.^{3} of water suffice. In experiments with solutions of NaCl, the salinity increasing by 0·005 from 0·005 to 0·045, the refractive index rose from 1·333804 to 1·34050 at 16° C. according to a straight-line law; experiments with diluted sea-water were also satisfactory. H. B.

718. *Measurements of End-standards of Length.* **P. E. Shaw.** (Roy. Soc., Proc. Ser. A. 84. pp. 589–595, Feb. 15, 1911.)—In 1905 the author showed [Abstract No. 1116 (1906)] that the best gauges were greatly defective as to their end faces, and the machines for their measurement were faulty in principle. Since then Johansen has produced gauges much superior to any previously on the market. The ordinary bar gauge has flat ends, and this form only is dealt with here. The method of measuring and the measuring machine have previously been described. A brief account is given of tests to determine how far several gauges fulfilled the condition that their ends should be plane and parallel, though not necessarily truly normal to the length of the bar. Point-to-point measurements were made between the two ends along parallel lines, the number of measurements being usually 13, and curves are plotted showing the variations in the readings for the different points, distributed regularly over the faces. The curves for ordinary commercial gauges exhibit marked sinuosities, but some gauges specially made by Manlove and Alliott (Nottingham) give almost straight lines. Tests on some Johansen gauges showed that over a surface 35 mm. by 10 mm. they were accurately plane to within 0·3 micron. Some improvements of the measuring machine are described. A. W.

719. *Friction.* **F. Charron.** (Comptes Rendus, 151. pp. 1047–1049, Dec. 5, 1910.)—Continuing his researches on the effect of the air layer between two surfaces where sliding is occurring [Abstract No. 1067 (1910)], the author has studied, using certain simplifications, the motion of a fluid between two plane surfaces very close together and nearly parallel to one another. One plane is taken as xz; the other is limited by $x=0, x=a, y=h_0$, $y=h_0(1+m)$ where m is a constant; it is situated above the first at a variable height $h=h_0(1+mx/a)$. The upper plane is fixed and the lower has a velocity u_0 parallel to Ox. Then for a "rubber" of length b the tangential component of the pressure applied is given by—

$$V = -[2ab\epsilon u_0/h_0]\left\{8/(2+m) - \log(1+m)/m\right\}.$$

ϵ is the coefficient of viscosity of air. This can become zero and change sign for certain values of m. The formula was verified by means of the apparatus previously described. The effect of rarefaction of the gas is also dealt with. When sliding takes place between two plane faces, the presence of the air film between causes a variation of the normal component of the mutual reaction, and adds to the tangential component due to pure friction a viscosity term. The formulæ given show that the total tangential force X, which is directly measurable, would be given by $X = \alpha' \pm \beta' u_0$. The magnitude and sign of the second constant depend on the form of the layer of air between the two quasi-plane surfaces. With "rubbers" suitably chosen, the author has been able to observe apparent frictional forces increasing or decreasing linearly with the velocity. A. W.

720. *General Formulæ for Shearing Deflection of Beams of Arbitrary Cross-section, either Variable or Constant.* **S. E. Slocum.** (Frank. Inst., Journ. 171. pp. 365–389, April, 1911.)—In determining deflection of beams, the effect of shear is usually neglected. The reason is that deflection is usually determined from the equation of elastic curve. The author uses the principle of least work to obtain a general formula for the shearing deflection of beams of arbitrary cross-section, which latter may be either variable or constant. The same method is also applied to derive the Frænkel formula for flexural deflection. It is further shown that all the ordinary formulæ for either flexural or shearing deflection are special cases of one or the other of the above. Numerical application of these formulæ is then made to the rail of a planer, in which both the cross-sectional area and its moment of inertia are variable. In the case of the planer the load on the point of the tool also produces a torsional strain in addition to shear and flexure, and the total horizontal deflection at the point of the tool due to flexure, shear, and torsion is found. C. A. M. S.

721. *A Method of Calibrating Fine Capillary Tubes.* **T. R. Merton.** (Phil. Mag. 21. pp. 386–390, March, 1911.)—The ordinary methods of determining the bore of a capillary tube are by optical measurement of the bore and weighing a drop of mercury which occupies a known length of the tube. The author's experiments were made with the object of investigating the accuracy with which a measurement of the electrical resistance of a fine glass capillary filled with mercury can be made. From this a mean value for the radius of the tube is computed. A correction is made for the curvature of the stream-lines of current at the ends of the tube. The results prove that the method is simple and accurate. A. R.

722. *Flow of Gas in Capillary Tubes.* **W. J. Fisher.** (Phys. Rev. 32. pp. 433–436, April, 1911.)—Meyer's formulæ for determining the viscosity coefficients of gases and vapours ceases to be a good approximation when the temperature of the capillary is below or near the critical temperature of the substance, as it assumes Boyle's law to be obeyed. This was noticed in previous work on the viscosity of nitrous oxide [Abstract No. 661 (1909)]. The present note treats the approximate theory of the gas-flow when Boyle's law is not obeyed. If M is the mass of gas passing per sec., α and β functions of the temperature of the capillary, to be determined experimentally, l is the length of the tube, p_1 and p_2 the end pressures, a the radius of the tube, ζ the slip-coefficient (assumed constant), then it is shown that—

$$M=\frac{\pi a^4}{8\eta l\beta}\left(1+\frac{4\zeta}{a}\right)\left[\frac{p_1^2-p_2^2}{2}-\frac{\alpha}{\beta}\cdot\frac{p_1^3-p_2^3}{3}+\frac{\alpha^2}{\beta^2}\cdot\frac{p_1^4-p_2^4}{4}\ldots\ldots\ldots\right],$$

where η is the viscosity coefficient. Neglecting all but the first term in square brackets gives Meyer's equation; the other terms may be regarded as corrections, depending on the value of α/β. Taking only one of these correction terms, the approximate formula—

$$\eta=\frac{\pi a^4}{8Ml\beta}\left(1+\frac{4\zeta}{a}\right)\left[\frac{p_1^2-p_2^2}{2}-\frac{\alpha}{\beta}\cdot\frac{p_1^3-p_2^3}{3}\right]$$

is obtained. For high temperatures the importance of the correction terms diminishes, as the deviations from Boyle's law are then less. It is to be noted that the first equation gives a convergent result only if $(\alpha p_1/\beta)<1$.

A. W.

723. *A Method of observing Stream-lines in Air.* **A. Lafay.** (Comptes Rendus, 152. pp. 318–320, Feb. 6, 1911.)—The method in question employs a thin stream of acetylene issuing from a nozzle 2 to 3 mm. in diam. Such a stream will, when illuminated, cast upon a screen a refraction shadow consisting of a bright line between two dark ones. The path of the gas is thus rendered visible. The acetylene should issue from the nozzle at the same velocity as that of the air current in which it is immersed. The method may be used to detect variations in the speed of the air by the discontinuity of the shadow. If the acetylene is cooled to about 30° C. below the temperature of the air, or if it is mixed with CO_2 in the preparation $3C_2H_2$ and $3CO_2$, it will have the same density as the air. If the smell of acetylene is objectionable ethylene may be used.

C. A. B.

724. *Measurement of Wind Velocity by means of a Stream of Acetylene.* **A. Lafay.** (Comptes Rendus, 152. pp. 694–696, March 13, 1911.)—Measurements of wind velocity made by anemometer and Pitot-tube methods show discrepancies amounting to 25 per cent. when applied to the measurement of powerful blasts [see Abstracts Nos. 1990, 1991 (1909)]. A stream of acetylene produced as described in the preceding Abstract may be employed to measure such wind velocities in the following manner; A perforated diaphragm is rotated at a known speed between two abutting sections of the tube carrying the gas; thus interruptions of known interval are caused in the stream, the shadow of which is photographed on a sensitised plate by means of a distant electric spark. The wind velocity is calculated from the space and time intervals thus obtained. Observations thus made showed the wind velocity to be variable owing to turbulence. A series of fifteen measurements, giving a mean velocity of 11·8 m. with a maximum of 18·2 and a minimum of 10·8, indicated 9 m. with a Pitot tube and 11·1 m. with an anemometer. Further experiments resulted as follows :—

	Wind Velocity, m./sec.			
By Pitot tube............................	9·0	18·5	19·5	24·0
By anemometer	11·1	16·5	28·4	80·8
Mean of photographic method ...	11·8	16·0	22·5	29·0

The discrepancies will vary with the wind apparatus used. If the illuminating spark be replaced by an arc, the light from which is interrupted by a rapid shutter, the shadows traced by the successive puffs of gas will have a fibrous appearance, and will indicate the structure of the air current in the neighbourhood of the stream. If a suitable jet-plate be substituted for a single jet the structure of the entire aerodynamic field may be studied simultaneously.

C. A. B.

725. *Pitot Constant.* **J. D. Fry and A. M. Tyndall.** (Phil. Mag. 21. pp. 848–866, March, 1911.)—Experiments on the value of the Pitot constant are described. The centrifugal method was first employed, various causes of irregularity being eliminated as far as possible, and special precautions being taken to secure a constant turning couple. It was found by this method that the Pitot constant (K) has the value 1·002 for all velocities between 60 and 1400 cm. per sec., *i.e.*, $v = 1{\cdot}002\sqrt{2P/\rho}$, where ρ is the gas density and P the excess pressure over the static pressure at the open end of the Pitot tube. A pipe method was used later, and from the results it appears that the method of determining the Pitot constant by measuring the distribution of Pitot pressure across a pipe is unreliable at small velocities. If a small correction proportional to the mean rate of flow through the pipe is added to all the Pitot pressures across a section of the pipe, this method also leads to a value for K of 1·00 between the limits 6–2000 cm. per sec. A very small Pitot tube possessing very thin walls gives in general a Pitot constant several per cent. above unity. This is readily explained in terms of effects known to be present at the edges of plane surfaces placed normal to a current of air.

A. W.

726. *Movement of a Coloured Index along a Capillary Tube.* **A. Griffiths.** (Phys. Soc., Proc. 28. pp. 190–197 ; Discussion, p. 197, April 15, 1911.)—If a fine capillary tube, originally full of water, is fed with a weak fluorescein solution at a rate so rapid that the diffusion of the fluorescein may be neglected, the vertex of the coloured paraboloid moves at double the mean speed of the liquid. But at slow speeds radial diffusion plays an important part, and the colouring matter travels along the tube approximately as if the liquid moved in a solid column. If, after a short length of fluorescein solution has been introduced into the tube, the supply of solution is replaced by water, a symmetrical coloured column of slowly increasing length is obtained, the centre of which indicates the mean speed of the liquid. Experiments are described illustrative of the elementary theory given, and various methods of observing the position of the index are dealt with. An interesting photographic method consists of taking a photograph of the position of the index with scale behind, then cutting the plate in halves and matching the ends of the index. An arc lamp was used as illuminant, and for eye observations the light was transmitted through blue glass, the capillary tube being placed

on a black scale with white graduation marks. The method can be adapted for the measurement of the flow in a closed circuit. At the speeds dealt with in the experiments (0·2 to 4 cm. per hour) it is comparatively easy to determine the mean speed of the liquid to an accuracy of 0·2 per cent. A. W.

727. *Flow of Thin Liquid Films.* **W. G. Royal-Dawson.** (Nature, 86. p. 110, March 23, 1911.)—While observing Brownian movements of particles of gamboge in water, the author pressed gently on the cover-glass of the slide so as to cause a movement of the water containing the suspended matter, and observed the paths of the particles in the vicinity of some larger stationary masses. G. Stokes' assertion that liquids in thin films behave as frictionless fluids was fully confirmed. The moving particles showed no trace of eddy currents; they passed along the edges of the obstacles and left them without any swirls. The moving particles next to the obstacle had a high velocity, and were in greater numbers per unit area than those further removed; the obstacle had no effect upon distant portions of the liquid; they moved in straight lines. With high velocities, however, a cone of slow-moving liquid formed both in front of and behind the obstacle. A hydrodynamical analogue to the Wheatstone bridge is produced by sending the stream against two obstacles in succession. When an air-bubble moves through the liquid, the fluid next to it moves along its edge in the same direction, while at a little distance it moves in the opposite direction. The effect extends much further than it does in the case of the solid obstacle. E. E. F.

728. *Uniform Rotation on Relativity Principle.* **H. Donaldson** and **G. Stead.** (Phil. Mag. 21. pp. 319–324, March, 1911.)—The authors showed previously [see Abstract No. 1072 (1910)] that, on the relativity principle, a rotating disc must be conceived as assuming a cup-like form, for the circumference contracts while the radius retains a constant value. It is now shown that this conception harmonises with the relations reached by other methods as to the linear shrinkage, the change of time, &c. E. H. B.

729. *Uniform Rotation of Cylinder and Relativity Principle.* **W. F. G. Swann.** (Phil. Mag. 21. pp. 342–348, March, 1911.)—As to the difficulties involved in the problems of uniform rotation viewed on the relativity principle, it is pointed out here that the apparent inconsistencies arise from neglect of considering all the phenomena involved. Thus each particle moving in a circle has an acceleration towards the centre; and the circumference, so far from contracting, will probably expand owing to centrifugal force, and to an extent depending on the elastic properties of the material. If all internal forces, cohesion included, are regarded as being of electromagnetic origin, it is considered likely that a complete electromagnetic solution of the problem would show that the cylinder actually does expand, the centrifugal force being involved in the electromagnetic scheme. A mathematical treatment of the problem is then given. E. H. B.

730. *The Kinetic Theory of Gases and the Realisation of a Material Radiation of Thermal Origin.* **L. Dunoyer.** (Comptes Rendus, 152. pp. 592–595, March 6, 1911. Le Radium, 8. pp. 142–146, April, 1911.)—The author describes the following experiment, which he considers affords evidence of the kinetic movement of molecules in a gas. A cylindrical tube is divided

into three compartments by means of partitions perpendicular to the axis of the tube; these partitions are pierced in their centres by a small hole, so as to form diaphragms. The tube is placed vertically, and in the lowest compartment there is placed a substance non-volatile at the ordinary temperature, *e.g.*, sodium, and the tube is then exhausted. The lowest compartment is then heated so as to vaporise the sodium. The molecules of the vapour move in all directions in the lower compartment with a mean velocity corresponding to the temperature employed. Some of them traverse the lowest diaphragm; the majority of them strike the walls of the tube or the lower surface of the upper diaphragm and form a deposit there. Some, however, pass through the hole in the second diaphragm. Among these molecules very few will collide, because their velocities are almost all in parallel directions, and since foreign gases are absent or negligible, these molecules will continue on their straight course, with a mean velocity of the order of 550 metres per sec. if the sodium was heated to 400°, until they strike against the end of the tube. From this they rebound and collide with ascending molecules, and are ultimately deposited on the end of the tube. If an obstacle is placed in the path of the molecules, a shadow will be formed or even an umbra and penumbra. On the side walls of the upper compartment no deposit is formed. By this experiment the author considers that he has shown the rectilineal propagation of something material; and also that this is not a mere turbulent jet of gas, but the propagation, in parallel straight lines, of particles. A. F.

731. *Angular Rotation of Solar Prominence.* **J. Evershed.** (Astrophys. Journ. 33. pp. 1–7, Jan., 1911.)—In a note by Slocum [Abstract No. 28 (1911)], the development of a prominence was followed closely, and it now appears that the same object was photographed with the spectroheliograph at Kodaikanal, India, at each successive appearance on the sun's limb. In contrast to the experience at Yerkes, the prominence is well shown as a dark absorption marking on the K_2 flocculi plates. The marking is so prominent that measurements were taken of it in order to determine the speed of angular rotation. The series show that the prominence endured in a more or less compact form for 82 days, the greatest development on the limb being on March 18, 1910, when its height was 100″. If the gases are being projected from numerous orifices in the photosphere, the rotations deduced at the limb will not give the true rotation of the chromosphere as a layer, but of these orifices. Adams has found that the angular rotation of the chromospheric layer is about 6·5 per cent. greater than that of the photosphere as determined from spots and faculæ, indicating that the prominences when projected into the chromosphere would experience a westward drift over the photosphere. This is confirmed by the measurements by the present writer; from the measures of the absorption markings the mean daily sidereal motion comes out to be 15°·09 for the point in latitude +0°·4, and 16°.05 for that in latitude +8°. Taking a well-marked calcium flocculus in latitude −8° its mean daily sidereal motion is found to be 14°·48. There is evidence that during the above period of observation several distinct masses of vapour were observed, but that they emanated from a common origin. Other measures with a spectograph of the Hα line outside and inside the limb with a radial slit indicate an excess of motion in the prominence of +0·68 km. per sec.

C. P. B.

732. *Motions of the Solar Atmosphere.* **H. Deslandres.** (Comptes Rendus, 152. pp. 238–239, Jan. 30, 1911.)—Working with the "spectroheliograph of velocities," it has been determined that the vapours over filaments in the solar atmosphere are in general ascending, and over faculæ they are descending, in relation to the neighbouring vapours. In the integrated solar spectrum the central high-level line K_3 is displaced towards the red, indicating general movement away from the earth. Jewell and St. John have also found this displacement, of which the mean amount corresponds to a velocity of recession of 1·4 km. per sec. Recent measures at Meudon have been directly reduced with a terrestrial comparison spectrum. At the east limb there is a negative displacement of less amount than the positive displacement at the west limb. The centre of the disc gives a positive displacement, except in the case where that region is occupied by a filament. The general character of the motions observed is discussed from the idea of their being resultants of outward motions of solar vapours and rotational motion of the sun round its axis. C. P. B.

733. *Structure of the Solar Corona.* **C. Störmer.** (Comptes Rendus, 152, pp. 425–428, Feb. 20, 1911.)—Following the hypothesis of Birkeland as to the production of magnetic storms and auroræ by the emission of electrified corpuscles from the sun, it is a simple step to imagine the solar corona as due to a similar cause. The structure of the corona has for long induced the idea that the sun is surrounded by a magnetic field, the coronal rays giving the impression of lines of force. Assuming the sun to act as a simple magnet, it is assumed that the corpuscles are only subject to this magnetic force, and that they move in accordance with the laws of kathode corpuscles in a magnetic field. The forms computed show on projection very suggestive similarities to the coronal streamers. C. P. B.

734. *Photographic Observations of Prominences.* **G. Abetti** and **R. E. Smith.** (Astrophys. Journ. 33. pp. 141–160, March, 1911. Contribution from the Mt. Wilson Solar Observatory, No. 51.)—An examination has been made of a large number of prominences photographed at Mt. Wilson and Yerkes with instruments giving solar images of nearly the same scale. At Mt. Wilson from 1906 to April, 1908, the photographs were made in calcium (H) light, and afterwards in hydrogen (Hα) light. At Yerkes the calcium H line is used. Curves are given showing the variation of prominence areas with solar latitude, and also a time curve showing the variation from 1906–1908, using rotation intervals of 27·5 days. In considering the heights it is found that the mean height of the calcium prominences is about 47″, while that of the hydrogen prominences is about 39″. A table is given showing the details of all the prominences examined. C. P. B.

735. *Pyrheliometric Scale for Solar Radiation.* **C. G. Abbot** and **L. B. Aldrich.** (Astrophys. Journ. 33. pp. 125–129, March, 1911.)—In the early work of the Astrophysical Observatory of the Smithsonian Institution, Washington, a modification of Tyndall's actinometer was employed, the heat being received by a copper box filled with mercury. It was always suspected, however, that the scale given by this was subject to errors of unknown amount, though it was more convenient to use than the alcohol actinometer of Crova. From the experience gained during work from 1902–1904 a new pattern standard pyrheliometer was designed. This comprised a cylindrical chamber of the form of a large test-tube blackened within, with hollow walls adapted for the circulation of a liquid. The sun's rays shine into this chamber through a measured aperture, and heat the walls at the rear end. A stream of water flowing at a measured rate removes the heat as fast as formed, independently of its distribution within the chamber. Any heat that escapes capture at the rear end of the chamber will be gathered somewhere along the sides, excepting the negligible amount escaping at the front orifice. Four Pt-wires are bathed in the water, two at the entrance, two at the outflow of the stream, and are joined with the necessary electrical accessories to form a resistance thermometer. This serves to measure the rise of temperature of the water due to solar heating. By increasing the rate of flow the rise of temperature may be diminished until the escape of heat on the outside walls of the chamber becomes negligible. Various preliminary experiments with two actinometers of this pattern have resulted in their being adopted for final determinations of the solar constant on Mount Wilson, California, their scales having been obtained in absolute measure. C. P. B.

736. *Circulation in the Solar Atmosphere.* **F. Slocum.** (Astrophys. Journ. 33. pp. 108–114, March, 1911.)—A detailed study has been made of 3323 prominences photographed in H (calcium) light between Jan., 1904, and Dec., 1910, at the Yerkes Observatory, and from the results of the examination it is decided that there is evidence of the existence of horizontal currents in the solar atmosphere. For the discussion the prominences have as far as possible been grouped into classes according to their forms, details being noted of the limiting latitude, direction of movement, max. height, and type. Then summaries were made by counting the number of directional prominences in each 5° zone from the north to the south pole. The average height of the prominences was 30,000 km. The main conclusions are: (1) There is a tendency for movement towards the poles in middle latitudes. (2) There is a tendency for movement towards the equator in high latitudes, more marked in the north than in the south hemispheres. (3) The equatorial conditions are almost neutral. (4) The northern hemisphere exhibits much greater changes of tendency to movement than the southern. It is proposed to make further investigations of these surface currents, and to determine the drift of quiescent prominences in the line of sight. C. P. B.

737. *Selective Reflection of the Moon's Surface.* **A. Miethe** and **B. Seegert.** (Astronom. Nachr. No. 4489. Nature, 86. p. 254, April 20, 1911. Abstract.)—The authors have continued the work of R. W. Wood by photographing the moon through colour screens with a reflecting telescope. The higher parts of the lower surface, in the south polar region and near Copernicus, reflect a large proportion. Notable differences are shown in the Sinus Roris and Mare Nubium. C. P. B.

738. *Satellites of Mars.* **P. Lowell.** (Lowell Observatory Bull. No. 50. Nature, 85. p. 552, Feb. 23, 1911. Abstract.)—The determination of the magnitudes of the two satellites of Mars is given from observations made during the opposition of 1909. It is concluded that Phobos is 2·48 times the diam. of Deimos, with about 15·25 times its mass. Evidence is adduced of the existence of local variations of albedo on each satellite. C. P. B.

739. *On the Periodic Times of Saturn's Rings.* **H. Wilde.** (Manchester Lit. and Phil. Soc., Mem. 55. No. 14. (pp. 1–8), 1910–1911. Chem. News, 103. p. 241, May 26, 1911.)—In the paper on the "Origin of Saturn's Rings," read by the author last year [Abstract No. 1688 (1910)] a new determination was made of the periodic times of the rings based on the

commonly accepted distance of Mimas, 3·36 Saturnian units, from observations made by Herschel and subsequently adopted by all astronomical writers. Recent observations of American astronomers with more powerful telescopes and under more favourable conditions have reduced the distance of Mimas to 3·16 units, with the consequent increase in the times of rotation of the rings. The difference between the older and later determinations is sufficiently large to induce the author to place on record the results computed from both observations and Kepler's third law. The later result shows for the outermost circumference of the outer ring a periodic time of 14 hours 4 minutes, and for the inner edge of the dusky ring a period of 5 hours 45 minutes. That the rings are ejectamenta from the interior of Saturn is further evident from the fact that no causal connection subsists between their times of rotation and that of the planet itself, as the period of the dusky ring is little more than half the time of Saturn's rotation, 10 hours 13 minutes. The same conclusion may also be drawn with reference to the origin of the two satellites of Mars, as Phobos has a period of only 7 hours 39 minutes, while the axial rotation of the planet is 24 hours 37 minutes. The comparative minuteness of these bodies, which are estimated to be less than 10 miles in diameter, indicates them as ejectamenta rather than the successive condensations of a nebular substance surrounding the planet. Saturn's dusky ring and the inner satellite of Mars are the only bodies in the solar system that revolve in a shorter time than their primaries. A. P. H.

740. *Nova Lacertæ.* **M. Wolf, E. E. Barnard, Münch and Eberhard.** (Astronom. Nachr. Nos. 4466, 4467, 4468. Nature, 85. p. 453, Feb. 2, 1911. Abstract.)—Wolf gives a reproduction of region round the new star in Lacerta taken on Jan. 2 with an exposure of 31 minutes. A star is shown also in photograph of the same region in 1904 and 1894. Barnard confirms the presence of a star in the position of the Nova on plates taken in 1893, 1907, and 1909. Münch and Eberhard obtained spectra of the Nova at Potsdam on Jan. 6, 7, and 8, showing a number of bright lines and bright continuous spectrum. **M. Wolf.** (L'Astronomie, Feb., 1911. Nature, 85. p. 552, Feb. 23, 1911. Abstract.)—Gives reproduction of spectrum of Nova Lacertæ, obtained at Heidelberg on Jan. 2, showing in addition to bright hydrogen lines a band at λ4056. **E. C. Pickering, P. Idrac, M. Wolf.** (Astronom. Nachr. 4470, 4471. Comptes Rendus, 152. pp. 302–303, Feb. 6, 1911. Abstracts in Nature, 85. p. 523, Feb. 16, 1911.)—Pickering gives particulars of earlier history of star, and announces that a photograph of spectrum shows 11 bright lines. Idrac describes photographs of spectrum obtained at Meudon. **Münch.** (Astronom. Nachr. No. 4490. Nature, 86. p. 254, April 20, 1911. Abstract.)—Spectrograms obtained at Potsdam on Jan. 6, 7, 8, 23, 1911, furnish measures of the chief constituent lines. Some of the lines were asymmetrical, the max. intensity being on the less refrangible side. **M. Wolf.** (Astronom. Nachr. No. 4473. Nature, 86. p. 24, March 2, 1911. Abstract.)—Description and reproduction of photographic spectrum of Nova Lacertæ taken with Zeiss 2-prism spectrograph on Jan. 13 with an exposure of 90 min. Seven broad bands are shown, six of which are ascribed to hydrogen. C. P. B.

741. *Spectrum of Halley's Comet.* **C. P. Butler.** (Roy. Soc., Proc. Ser. A. 84. pp. 523–526, Jan. 26, 1911.)—Observations were made on May 22, 23, 26, at Fosterdown. Photographs were taken with a camera of 6 in. aperture and

5 ft. focal length, and spectra with an ultra-violet spectrograph having a 3-in. lens of 18 in. focal length and a 80° prism. The comet was about as conspicuous as a 2nd magnitude star. The spectrum was seen as a small nebulous cloud 3′ to 5′ diam. with a central brightening. On May 28 there was a secondary condensation. The colour of the head was pale lilac, like that of a vacuum-tube discharge in carbon compounds under feeble excitation without capacity. The tail was straight so far as it could be followed. On May 26 it was traced for 8° or 10° towards the SE. Visual observations of the spectrum showed no appreciable relative changes in the bands between May 22–26. The nucleus showed a very strong continuous spectrum intensified by three bands, presumably the usual cometary bands at λλ 5635, 5165, 4737. The spectrum of the coma consisted of the same three bands extending the whole length of the slit, with no continuous spectrum. The general appearance of the spectrum differed somewhat from the ordinary fluted spectrum of carbon compounds. The max. intensity appeared nearer the centre of each band, resembling spectra under medium pressures rather than the more complicated fluted structure seen under low pressure with electric excitation. The photographic spectrum shows two conspicuous bright bands λλ4737 (int. 10) and 3884 (int. 6), with fainter bands at 4050, 4380, 5165, and 5635. Photographs taken elsewhere at different times show important differences of intensity from those taken at Fosterdown. Such differences are not necessarily physical, or due to real cometary changes. They may be due to atmospheric or instrumental, &c., differences, or to presentation of different portions of the comet. Some preliminary experiments have shown that remarkable changes of intensity of the carbon bands may be brought about by simple variations of the conditions of volatilisation. A. E.

742. *Sequence of Chemical Forms in Stellar Genera.* **N. Lockyer.** (Roy. Soc., Proc. Ser. A. 84. pp. 426–432, Dec. 15, 1910.)—In the Bakerian Lecture, 1873, the author had proposed a scheme of grouping the then known facts of celestial spectroscopy into a working hypothesis involving the factor of dissociation of various degrees in the reversing layers of the sun and stars. On this view the hotter a star, the simpler would be its spectrum. Very soon it was found that the constituents of stars and sun were not different elements, and the idea then formulated was that the chemistry of the stars was determined by temperature, including in this term the effects of electrical excitation. In 1888 the meteoritic constitution of celestial bodies was considered, and in 1892 the evidence of a preliminary photographic survey of stellar spectra was discussed in relation to chemical variations and extension of continuous spectrum. By the end of 1897 the problem had received a wealth of new evidence by the investigations on the new gas helium and the enhanced lines of the elements, and later, further evidence was accumulated by studying the extensions of the continuous spectrum on photographs of stellar spectra taken with a quartz-calcite train. Taking the elements which are chiefly prominent in stellar spectra, their various modifications are arranged in a diagram showing how they occur in the different groups, one set of elements appearing in a certain class of stars, gradually giving way and being replaced by others as the scale of stellar temperature is traversed. This is interpreted to mean that the elements concerned are subject to dissociation as the temperature is raised. With the finer criteria thus available it is now possible to divide the main groups of stellar spectra into sub-groups dependent on the varying intensities of the component lines of the chief elements concerned in their constitution. Attention is called to the main division of stellar spectra into two groups: one of increasing temperature, evidenced by the hydrogen lines being thin, as in α Cygni, and the other of decreasing temperature, with broad hydrogen lines, as in Sirius. As an example of the delicacy of the tests now available, a description is given of the spectrum of ϵ Ursae Majoris, in which the enhanced lines of Cr are very strongly developed, while the strong Ba line normally present in stars of the Sirian type is absent. The chemical forms traced up to the present in stellar spectra appear to be associated with the elements of low atomic weight. C. P. B.

743. *Photographic Determinations of Stellar Parallax.* **F. Schlesinger.** (Astrophys. Journ. 33. pp. 8-27, Jan.; 161-184, March, and pp. 234-259, April, 1911.)—In a previous paper [Abstract No. 456 (1911)] the author has described the instrumental methods adopted for the determination of stellar parallaxes with the 40-in. Yerkes telescope. In the present paper the methods of reduction are considered in detail. It was decided to employ rectangular co-ordinates, and to measure the longitude components only, this being in general the direction that yields the max. weight for the deduced parallax. A special measuring machine was designed for the work, in which one division on the divided head of the micrometer wire was equivalent to 0″·027 on plates taken with the 40-in. refractor. A discussion of several plans of work is also given at length. C. P. B.

744. *Quantitative Determination of Stellar Spectral Types.* **S. Albrecht.** (Astrophys. Journ. 33. pp. 130-140, March, 1911.)—In a former paper the author discussed the relationship between stellar spectral types and the intensities of certain lines in their spectra [Abstract No. 199 (1907)], showing that the wave-lengths of certain lines varied according to the spectral type, being progressive from F to M6 on the Harvard scale. The present paper deals with the inverse problem, viz., having obtained a series of determinations of variations of wave-length, to deduce therefrom the spectral type. A series of measurements from photographs taken with the Mills spectrograph are plotted against the spectral type, and the curves of variation drawn. This gives a series of curves for certain standard lines. By then finding the wave-length of any of these lines in any other star, and adjusting to the curve of that line, the spectral type may be determined. A table is given showing the result of such an application to several stars, from which a good degree of agreement is evidenced. C. P. B.

745. *Spectrum of o Persei.* **F. C. Jordan.** (Allegheny Observatory Publications, Vol. 2. No. 10. Nature, 86. p. 91, March 16, 1911. Abstract.)—The author discusses the results of a series of measures from 70 plates of spectra of the spectroscopic binary o Persei with the Mellon spectrograph during 1908-9. The velocity of the system is given as +18·5 km. per sec., the orbit being practically circular with a period of 4·4192 days. Abnormal velocities are got from the H and K lines of calcium. C. P. B.

746. *Radiation producing Aurora Borealis.* **L. Vegard.** (Nature, 86. pp. 212-213, April 13, 1911.)—Following the idea put forward by Birkeland that the phenomena of the aurora borealis and magnetic disturbances are produced by electric radiations emanating from the sun, it is pointed out that there are certain facts of observation which may enable the distinction to be made whether this electric radiation is of the type of α-rays consisting of

atoms or of β-rays composed of corpuscles. From the position of the auroral zone Birkeland has already estimated the average "stiffness" or resistance to deviation in a magnetic field, and finds them about ten times as stiff as ordinary α-rays. Now, as the law governing the absorption of the rays by matter is very different in the two cases, this factor may be of considerable help in the elucidation of the problem. According to Birkeland we see, in the aurora, the result of the impact of the solar rays on the outer strata of our atmosphere, and it may be possible to determine the mode of absorption by closely studying the forms of the luminosity areas. One of the most conspicuous forms of aurora is the drapery structure, in which the radiating linear filaments constituting each fold are sharply marked. At times there appears to be an actual transition of the luminous matter in the direction of the streamers, and this feature is strongly suggestive of the presence of α-rays. Looking at the luminosity across the transverse streamers, we shall always notice that the intensity gradually increases downwards but stops all of a sudden, just as is found for the ionisation produced by an α-particle along its path. If this is correct, it means that the rays producing the draperies are of atomic size and carry an electric charge. The further fact that the phenomena occur mostly on the evening and night side of the earth should, according to the law of the magnetic deflection, require a negative charge for the rays; this would involve no theoretical difficulty, as Thomson has found other rays formed by atoms carrying a negative charge accompanying the positive rays in a vacuum tube. The existence of such radiation does not exclude the existence of corpuscular rays, that may be the cause of the auroral "arch," which has generally a diffuse appearance; the magnetic disturbances may also be largely due to radiation of the β-ray type. C. P. B.

747. *Zodiacal Light.* **Birkeland.** (Comptes Rendus, 152. pp. 845–848, Feb. 6, 1911.)—Several observers have found that the zodiacal light sometimes presents very regular pulsations in intensity and form. The author finds that these pulsations correspond very closely with the periods found for regular magnetic waves in the polar regions, thereby suggesting that the zodiacal light may have an electrical origin. Several experiments are described which were undertaken in the endeavour to illustrate this view. From these it is suggested that there may be a ring of luminous matter extending in the plane of the sun's magnetic equator. Reference is also made to the *Gegenschein* and the formation of luminous clouds. C. P. B.

REFERENCES.

748. *The 15-inch Gun from an Engineer's Point of View.* **H. J. Jones.** (Engineer, 111. pp. 457–458, May 5, 1911.)—Shows that with new ordnance the tendency is to somewhat reduce the muzzle velocity; also that the max. pressure shows no tendency to fall below 18 tons or to rise above or about 20 tons. Various points in the design of guns are discussed and the probable features of the 15-inch gun are outlined. C. A. M. S.

749. *Note on Bessel's Functions as applied to the Vibrations of a Circular Membrane.* **Rayleigh.** (Phil. Mag. 21. pp. 53–58, Jan., 1911.)

750. *The Heat of Mixture of Substances and the Relative Distribution of the Molecules in the Mixture.* **R. D. Kleeman.** (Phil. Mag. 21. pp. 535–553, April, 1911.)

LIGHT.

751. *Reflection of Ultra-violet Rays by Snow.* **J. v. Kowalski.** (Nature, 86. p. 144, March 30, 1911.)—Attention is drawn by the writer to the frequency of recent snowfalls in Switzerland during March, 1911, often followed by brilliant sunshine. Numerous photographs were obtained of the spectrum of the sunlight reflected from the snow, at an angle of about 45°. Times of exposure varied from 1 to 20 seconds, with a slit opening of 0·05 mm. The results show that the spectrum of sunlight reflected from snow reaches up to 295 $\mu\mu$. These tests were made between 10 and 12 a.m. at an altitude of 680 m. above sea-level. As it thus appears that the ultra-violet rays are reflected completely from snow, it is pointed out that dark glasses should be habitually worn to protect the eyes. C. P. B.

752. *Oscillatory Interference Bands.* **G. O. Squier** and **A. C. Crehore.** (Bureau of Standards, Bull. 7. pp. 131–142, Feb., 1911.)—Interference bands are produced between two optically true glass surfaces in the usual way. Any small movement of one surface relative to the other can be readily seen by the changes in the bands. Several instruments are described; the agents used to change the position of the surfaces, being (1) pressure of a gas, *e.g.*, the pressure produced in a stethoscope by the beating of an artery and communicated to the interference apparatus by a rubber tube; (2) heat produced by an electric current passing along an isthmus of thin metal between the optical surfaces; (3) electromagnetic movement of a telephone diaphragm due to a current; (4) electrostatic attraction between two metal films when the p.d. between them is varied. Rapid alternations would not be perceptible, but low frequencies of 4 or 5 per sec., such as are obtained in an ocean cable, can easily be seen and read on the Morse code. No numerical results or curves are given. P. E. S.

753. *Formula for Optical Instruments.* **A. S. Hawkesworth.** (Science, 33. pp. 249–250, Feb. 17, 1911.)—Suppose a ray of light to be reflected by a pair of plane mirrors, and ϕ to be the angle between the mirrors. If the incident ray lies in the plane perpendicular to both, then, of course, the doubly reflected ray crosses its original path at angle 2ϕ. But if the incident ray makes a variable angle θ with the plane perpendicular to both mirrors, then the crossing angle δ is given by the simple formula $\cos\theta \sin\phi = \sin \frac{1}{2}\delta$. A. E.

754. *Crova's Method of Heterochromatic Photometry.* **H. E. Ives.** (Phys. Rev. 32. pp. 316–323, March, 1911. Electrician, 67. pp. 249–250, May 26, 1911. Abstract.)—Crova's method of comparing illuminants differing in colour is based on the assumption that a measure of the relative luminosities at a particular point in the spectrum is equivalent to a comparison of the integral luminosities; this, however, only applied rigidly to continuous spectra. Even in this case, the author suggests, the method is essentially approximate; the wave-length that yields the best results within a certain range of black-body temperatures may not do so outside this range. The author presents some calculated curves showing the error involved at different temperatures. The best results were secured with the wave-length $\lambda = 0{\cdot}5675\,\mu$. At about 2000° the method is theoretically correct, but at 1500°, and again at 6000°, errors of nearly 4 per cent. are indicated. It is also pointed out that the correct wave-length is not necessarily identical with that corresponding to the max. sensitiveness of the eye as has sometimes been suggested. J. S. D.

755. *Photographic Irradiation.* **C. E. K. Mees.** (Astrophys. Journ. 33. pp. 81–84, Jan., 1911.)—The diam. of the photographic image of a star or spectral line is known to be different to the real diam. of the object, and as various systems of measurements of these quantities have been employed as criteria for photographic photometry, it becomes of importance to investigate their relation to each other. The general conclusion has hitherto been that the square root of the diam. of a star image is proportional to the logarithm of the exposures. Laboratory experiments were made with an illuminated slit photographed from a distance of 8 m. by a lens of 15 cm. focus, so that the reduction on the plate was about 20 : 1. The slit was illuminated by a Nernst burner, and the diam. of the developed images read with an eyepiece micrometer, one division of which = 0·0075 mm. The results confirm the law usually adopted. C. P. B.

756. *Photographic Reproduction of Documents by Reflected Light (Cataphotography).* **G. de Fontenay.** (Comptes Rendus, 152. pp. 1055–1057, April 18, 1911.)—These experiments are based upon facts observed by Yvon, Prompt, A. Dini, and also by Fournier d'Albe. A sensitive plate is placed in the printing frame with its glass in contact with the strong glass of the frame, the document to be reproduced is put in contact with the sensitive film, and the frame is then closed. When exposure takes place the black parts of the document absorb the incident light almost completely, while the white parts diffuse and reflect the light upon the corresponding portions of the sensitive film. On developing, a negative is obtained similar to that produced by copying a document, by allowing the light to pass through it to the film. It is found that it is best to expose the plate to the action of monochromatic light, and red gives the best results. Slow plates are the best for this purpose, and of the developers tried preference is given to diamidophenol. Coloured documents can be copied by this method, but it has not been found possible to reproduce the actual colours. Since the image is produced by light reflected from the surface of the object, it is possible to make copies of pages which are printed upon both sides, and further, it is also possible to dispense entirely with the printing frame. A. E. G.

757. *Sensibility of the Eye to Variations of Wave-length in the Yellow Region of the Spectrum.* **Rayleigh.** (Roy. Soc., Proc. Ser. A. 84. pp. 464–468, Dec. 15, 1910.)—Edridge-Green has introduced a method of classifying colour-vision by determining the number of separate parts or divisions in the spectrum within each of which the observer can perceive no colour difference. Movable screens are provided in the focal plane of the spectroscopic telescope, by which the part admitted to the eye is limited, and the limits are measured in terms of wave-length. Tested by this instrument a normal individual will mark out about 18 monochromatic patches, though some find as many as 29. The author was tested by this method, and the number of patches was found to be 17, but though in the yellow the limits of the patch

were separated by 15 times the interval between the D lines, under more favourable conditions he could discriminate by colour between points in the spectrum as close together as the two D lines. For this a colour-box [see Nature, 25. pp. 64–66, 1881, "Scientific Papers," I. p. 548, also Nature, Aug. 18, 1910] was used, giving different colours extending with uniformity over a considerable angular area (which is necessary for comparing colours with advantage), with the result already stated. The degree of sensitiveness is a little difficult to reconcile with the monochromatic appearance of a portion of the spectrum 15 times wider. It is probable that the gradual character of the transition is an obstacle to the recognition of differences. The question of angular magnitude may also enter. No doubt a very small apparent magnitude would be unfavourable. It is possible that in Edridge-Green's apparatus an eyepiece of higher power, with a corresponding augmentation of the intrinsic brilliancy of the source of light, would allow of an increase in the number of distinguishable patches. It is seen that the existence of "monochromatic patches" in the spectrum is far from meaning that the eye is incapable of making chromatic distinctions within their range. Nevertheless the method of thus classifying colour-vision is of interest, even if we fail as yet to understand exactly what it means. A. W.

758. *Selective Absorption and Anomalous Scattering of Light.* **W. H. Julius.** (Konink. Akad. Wetensch. Amsterdam, Proc. 13. pp. 881–897, March 23, 1911.)—The problem of a damped vibration system is examined analytically, using the method of Lorenz's equations of motion. It is considered that absorption of radiant energy only takes place when by resonance certain electrons are set vibrating to such a degree that energy is imparted by them, in an irreversible way, to other parts of the system to which they belong. Added to this resonance effect may be added the various degrees of scattering. These are discussed from Rayleigh's formulæ. The author concludes, as in former papers, that many of the observed phenomena of sun-spots and other solar features may be due to these causes of anomalous scattering. C. P. B.

759. *Intensity Distribution in Spectral Lines.* **P. P. Koch** and **A. E. Weber.** (Ann. d. Physik, 34. 3. pp. 377–444, March 9, 1911.)—The source of light employed was an Heræus amalgam lamp, and various cadmium and mercury lines were dealt with, special attention being given to the red Cd line. Measurements of the intensity distribution in the red Cd line were made by means of a 33-plate echelon, and a photometric method is given for determining the smallest line-displacements. The intensity distribution of the red Cd line was also determined, using (i) a Lummer-Gehrcke plate, (ii) a Michelson interferometer, (iii) a Fabry and Perot interferometer. The results obtained by the different methods are illustrated graphically and compared. The curves obtained with the echelon, the Lummer-Gehrcke plate, and the Fabry and Perot interferometer, are very similar in shape, the interferometer plates being silvered by kathodic deposition. With chemically silvered plates the curve is considerably broader, falling away more gradually from the central maximum. This phenomenon is still more evident in the curve obtained when using the Michelson interferometer. Other points of interest in the paper are photometric investigations of the Zeeman-effect with the mercury line 5790, and of the "ghost" lines given by a small echelon. A. W.

REFERENCES.

760. *On a Revolving Table Method of Determining the Curvature of Spherical Surfaces.* **G. F. C. Searle, A. C. W. Aldis,** and **G. M. B. Dobson.** (Phil. Mag. 21. pp. 218–224, Feb., 1911.)

761. *Optics of Moving Media.* **J. Ishiwara.** (Mathematico-Physical Soc., Tōkyō, Proc. 6. 1. pp. 2–8, Jan., 1911.)—Supplementary to the author's previous work on this subject [see Abstract No. 885 (1910)], and deals with the second postulate of the relativity theory and with the radiation pressure on a body moving in a vacuum. E. H. B.

762. *Stokes' Formula.* **M. Reinganum.** (Deutsch. Phys. Gesell., Verh. 12. 23. pp. 1025–1038, Dec. 15, 1910.)—A *résumé* of the various criticisms and corrections of Stokes' formula which have been put forward from 1893 to the present time. [See Abstract No. 885 (1910).] E. H. B.

763. *Transmission of Light through Transparent Inactive Crystal Plates; Observations in Convergent Polarised Light.* **F. E. Wright.** (Amer. Journ. Sci. 31. pp. 157–211, March, 1911.)—A discussion of the method of Becke (and the author's modification of this) of measuring the optic axial angles. L. H. W.

764. *The Polarisation Angle of Transparent Crystals.* **F. Schwietring.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 18. pp. 423–435, 1911.)—The present work aims at combining the greater generality of Neumann's definition with the clearness of MacCullagh's method. L. H. W.

765. *Doppler Spectrum of Hydrogen Canal Rays.* **H. v. Dechend** and **W. Hammer.** (Deutsch. Phys. Gesell., Verh. 13. 5. pp. 203–205, March 15, 1911.)—Experiments are here described which, it is argued, uphold the hypothesis of Gehrcke and Reichenheim as to the cause of the double maxima in hydrogen canal rays. Their supplementary hypothesis to account for the fact that the ratio of maxima distances may be greater than 1·41 is also upheld, and the deviations of experimental results from $\sqrt{2}$ is thus considered no proof against their original hypothesis. [See Abstracts Nos. 153 and 610 (1911).] A. E. G.

766. *Theory of Secondary Spectra.* **H. Harting.** (Zeitschr. Instrumentenk. 31. pp. 72–79, March, 1911.)—A discussion is here given of irregularities arising from incomplete "correction" of thin lens combinations in optical instruments. The optical properties of many of Schott's glasses are dealt with, and a table is given of some of the best combinations. The combination of fluorspar with boro-silicate crown (O. 3512) glass appears to give the best results. A. W.

767. *Zeeman-effect.* **W. Voigt** and **H. A. Lorentz.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 1. pp. 71–97, 1911.)—A mathematical treatment of emission and absorption in relation to the question of intensity measurements of the Zeeman-effect. The observations of C. Försterling on the bright red and the yellow He lines are discussed with reference to the theory here developed. [See also Abstract No. 423 (1908).] A. W.

768. *Oxygen Spectrum.* **H. Kayser.** (Ann. d. Physik, 34. 3. pp. 498–504, March 9, 1911.)—A detailed criticism of the conclusions arrived at by Steubing as the result of his research on the fluorescence and band spectra of oxygen [Abstract No. 64 (1911)]. The author has nothing to say against Steubing's experimental work, which presents some new points, but with his conclusions and the methods of arriving at them he totally disagrees, basing his criticism on the well-known researches of Deslandres, Liveing and Dewar, Meyerheim, and others. A. W.

HEAT.

769. *Note on the Temperature Scale between 100° and 500° C.* **C. W. Waidner and G. K. Burgess.** (Bureau of Standards, Bull. 7. pp. 1–8, Feb., 1911. Chem. News, 103. pp. 25–28, Jan. 20, 1911.)—In a previous paper [see Abstract No. 262 (1910)] the authors determined the melting- and freezing-points of a number of metals on the temperature scale defined by the Pt-resistance thermometer calibrated in ice, steam, and sulphur vapour (444·70° on the constant-volume nitrogen thermometer). In order to throw further light on the probable accuracy of the temperature scale so defined, in the interval 100° to 500° C. the authors have made some further measurements by the same method on the boiling-points of naphthalin and benzophenone, which temperatures have been determined by a number of observers using both Pt and gas thermometers. On the basis of sulphur boiling-point equal 444·7°, the authors give the following fixed points as best satisfying the available observations to 0·1° for the reproduction of temperatures in the interval 100° to 500° C.

	Freezing-points.		Boiling-points.
Tin	231·9° C.	Naphthalin	218·0° C.
Cadmium	321·0	Benzophenone	306·0
Zinc	419·4	Sulphur	444·7

As these temperatures are on the constant-volume scale, the reduction to the thermodynamic scale may be effected approximately by adding 0·2° at the sulphur point and a proportional amount at the lower temperatures, remembering that the correction at 100° is zero. A. F.

770. *Emissive Power of Wedge-shaped Cavities and their Use in Temperature Measurements.* **C. E. Mendenhall.** (Astrophys. Journ. 33. pp. 91–97, March, 1911.)—A discussion of the emissivity of a wedge-shaped aperture, particularly one with reflecting walls, leads to the conclusion that optical pyrometer observations on the inside of the wedge would give the true temperature of the outside surface. This is verified by experiment. The device is suggested as a simple means of accurately determining the true temperature of a radiating surface. A flat conducting ribbon, of uniform thickness and width, is heated by a longitudinal electric current, and folded on a line parallel to the length so that the cross-section is a narrow V of 10° opening. So far, the only methods available for determining the temperature of a radiating surface above 1700° C. have been based upon Stefan-Boltzman's law or Wien's equation, and give not the true, but the black-body temperature. A. E.

771. *The Lummer-Pringsheim Spectral-flicker Photometer as an Optical Pyrometer.* **E. Thürmel.** (Ann. d. Physik, 33. 6. pp. 1139–1160, Dec. 20, 1910. Extract of Dissertation, Breslau, 1910.)—By making use of the exactly known distribution of intensity in the case of a black-body which is caused to glow by electrical means, the sensitiveness of the eye for brightness is determined for different colours of the spectrum. The application of the

flicker principle to the colours of the spectrum permits, in conjunction with methods used in previous experiments, a great accuracy for the photometric adjustments. This is in agreement with the work of O. Stiller. It is further shown that the Purkinje-effect does not exert any disturbing influence on the measurements. The temperature of a black-body is determined for two different bright sources by the optical method and at the same time by means of a thermo-element. The temperatures calculated from the photometric measurements differ from those obtained from the thermo-element by 0·5 to 1·9 per cent. In practice the temperature of a furnace may be obtained to 1 per cent. W. C. S. P.

772. *Further Experiments with Liquid Helium.* **H. Kamerlingh Onnes.** (Konink. Akad. Wetensch. Amsterdam, Proc. 13. pp. 1093–1118, April 20, 1911. Communication No. 119 from the Phys. Lab., Leiden.)—In continuation of previous work the author has investigated the thermal properties of helium. The temperatures were measured by means of a constant-volume helium thermometer. In terms of the density of the gas at 0° C. and 760 mm., equal to 0·0001787, the density of the liquid at 4·29° (on helium thermometer) is 0·122, in place of 0·15 previously given. There appears to be a maximum density at 2·2° K. The vapour density of helium at 65·54 cm. and at a temperature of 4·29° K was found to be 69 times the normal density. Calculating B from the equation $pv - Rt = B/v$, B is found equal to $-0·000047$; at 3·23° K, B (by extrapolation) was found equal to $-0·000061$, which gives at 3·23° K, a saturated vapour density 24·5 times the normal. By means of these data, the constant of the Mathias diameter is calculated to be $-b_d = 0·255$. The critical virial ratio is calculated to be 2·68. From the properties of helium we are forced to question the significance of the absolute zero with respect to molecular attraction. The author has also determined the change in resistance of Pt, Ag, Au, and Pb at very low temperatures. A. F.

773. *Isotherms of Monatomic Substances and of their Binary Mixtures. IX. Behaviour of Argon with regard to the Law of Corresponding States.* **H. Kamerlingh Onnes** and **C. A. Crommelin.** (Konink. Akad. Wetensch. Amsterdam, Proc. 13. pp. 1012–1021, April 20, 1911. Communication No. 120a. from the Phys. Lab., Leiden.)—The object in view in studying the isotherms of monatomic substances is to obtain a mean reduced equation of state in the synthesis of which observations on monatomic substances should exclusively be used. It was to be expected that the special surfaces of state for the various monatomic substances should systematically differ from the enveloping surface and from each other in such a manner that a gradual transformation would change the xenon surface into those for krypton, argon, and neon, to finally assume a limiting shape in the case of helium. From the present work it is evident (as a first step) that the mean reduced equation of state for monatomic substances will show important characteristic differences from the general mean equation previously obtained. With regard to the deviations from the law of corresponding states, the authors have calculated certain important data, viz., the constant of van der Waals' vapour-pressure equation and the critical virial quotient. The values found are in better harmony with the theoretical values than in the case of most other substances. [See Abstract No. 501 (1911).] A. F.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

774. *Definition of Intensity of Electric Current.* **A. Occhialini.** (N. Cimento, Ser. 6. 1. pp. 65–78, Jan., 1911.)—Instead of the usual definitions based on hypothesis, the author attempts to deduce a definition of intensity of current directly from experiment. By connecting a Wimshurst machine with a Grassi voltameter and a Leyden jar it can be shown that the quantity of an electrolyte decomposed in a voltameter is independent of the time taken by the current to pass through it, of the dimensions and form of the voltameter, and also of the physical condition and concentration of the solution, depending only on, and being proportional to, the quantity of electricity passing through the voltameter, so that the quantity of electricity, and hence the intensity of current, can be defined in terms of the amount of electrolyte decomposed. **W. H. Si.**

775. *Electric Dust Figures.* **J. Robinson.** (Phil. Mag. 21. pp. 268–270, Feb., 1911.)—T. J. Richmond obtained dust figures from an electric spark, primarily with a view to ascertaining whether there was a connection between the ripple distance and the frequency of the electric oscillation of the spark. Such a connection he failed to find; but, on the other hand, he found a dependence of the ripple distance on the diam. of the particles in the powder used. The present author used an arrangement of condensers and an inductance so as to keep the electrical frequency constant throughout, but increased the intensity of the sparks producing the dust figures by increasing the spark-gap at which the condensers were charged. He thus found that when this primary gap was made in succession 1 in., 1¼, 2, and 2½ in. the distances apart of the consecutive ripples were respectively 0·898 mm., 1·04, 1·14, and 1·18 mm. The conclusion is accordingly formed that the ripples are comparable to those *between* the nodes in a Kundt's tube rather than to the nodes themselves. [See Abstracts Nos. 1045 (1907) and 135 (1910).] **E. H. B.**

DISCHARGE AND OSCILLATIONS.

776. *Mobility of Ions produced in Air during Hydration of Quinine Sulphate.* **M. de Broglie** and **L. Brizard.** (Comptes Rendus, 152. pp. 855–856, March 27, 1911.)—Employing a very large cylindrical condenser, and placing the quinine salt at the central electrode, which is of small diam., the field at this part being intense, whilst towards the side it is more feeble, and thus allows the ions to be partially removed by an air current, the authors have separated the ions and find their mobility to have a mean value of 1 cm. per sec. [See also Abstract No. 475 (1911).] **W. H. Si.**

777. *Electrical and Optical Behaviour of the Hydrogen Flame in Chlorine.* **J. Franck** and **P. Pringsheim.** (Deutsch. Phys. Gesell., Verh. 13. 8. pp. 328–334, April 30, 1911.)—When hydrogen burns in chlorine it is found that the mobility of the positive ions is many times greater than that of the negative. Free electrons do not appear to exist, the negative carriers apparently forming clusters. Corresponding to this it is found that the anode-fall is greater than the kathode-fall and the unipolar electrical conductivity of the flame is in the inverse sense to that which is usual with hot flames. Sodium chloride glowing in this flame does not produce any visible colouration—a phenomenon which is explained by the electro-negative behaviour of the chlorine. The D-line, however, appears when a spark is made to pass if the electrode is covered with salt. A. E. G.

778. *Photo-electric Effects in Colloid Alkali Metals.* **R. Pohl** and **P. Pringsheim.** (Deutsch. Phys. Gesell., Verh. 13. 5. pp. 219–223, March 15, 1911.)—A new explanation is put forward for the observation by Elster and Geitel [Abstract No. 958 (1910)] that alkali metals in the colloid state are three or four times more sensitive to white light than the same metals in the ordinary state. There is not only a greater absorption of the light, but the projected electrons, which ordinarily have only a limited angular range of emergence, are capable of emerging in all directions when the particles are small enough. This circumstance introduces a hitherto unknown error into the determinations of sensitiveness. For all disturbances of photo-electric amalgam cells produce electric charges tending to luminescence, and this suffices in turn to form a certain amount of colloidal amalgam which produces an apparent increase in the sensitiveness. Hence previous results must be corrected in this sense. E. E. F.

779. *Influence of Radium Rays on the Photo-electric Sensitivity of Metals.* **H. Dember.** (Deutsch. Phys. Gesell., Verh. 13. 8. pp. 318–327, April 30, 1911.)—W. Hallwachs has found that by exposing the metal to ultra-violet light, visible light, and to the β- and γ-rays from radium bromide, and for a short time to Röntgen rays, no observed alteration is produced in the photo-electric effect [see Abstract No. 46 (1905)]. Crowther [Abstract No. 798 (1908)] has observed that the rays from Ra produce a strong fatiguing action upon the metals, while L. T. More [Abstract No. 1888 (1907)] made the observation with newly polished lead and iron plates that under the influence of Röntgen rays an increase in the secondary radiation takes place. As the result of the present experiments it is found that the effect noted by Crowther is not due to the action of the rays themselves nor to the influence of the double gas-layer on the surface of the metal, but is caused by the ozone which is generated by the rays. With copper in a very high vacuum no sort of fatigue effect is observed under the action of α-, β-, and γ-rays. With Pt in a very high vacuum an increase in the photo-electric effect is produced when α-rays fall on the metal. This is explained by the impinging α-rays freeing the metal surface from absorbed gases. A lasting influence of the Becquerel rays upon the photo-electric sensitivity of the metal atom has not been demonstrated. A. E. G.

780. *Actino-dielectric Action with the Phosphorescent Alkaline Earths.* **C. Ramsauer** and **W. Hausser.** (Ann. d. Physik, 34. 3. pp. 445–454, March 9, 1911.)—During some researches upon the photo-electric effects observed with phosphorescent alkaline earths, Lenard and Saeland observed another effect produced when these bodies are illuminated in an electric field. This was named by them the actino-dielectric effect [see Abstract No. 873 (1909)]. This action has now been investigated, and the results obtained with short and long periods of lighting the phosphor are shown. It is shown that pre-

vious excitation of the phosphor by light is without influence on the effect. The influence of the intensity of the light used and the action of light of different wave-lengths is also examined. A. E. G.

781. *Speed of Electric Waves along Wires and that of Light.* **C. Gutton.** (Comptes Rendus, 152. pp. 685–688, March 13, 1911.)—Describes a special arrangement by which it is shown that the speeds of light and of electric waves of 0·85 to 1·8 m. wave-length along copper wires of 0·95 mm. diam. are the same within about 1 per cent. E. H. B.

782. *Slightly Damped Electrical Oscillations.* **K. Settnik.** (Ann. d. Physik, 34. 3. pp. 565–589, March 9, 1911. Inaug. Dissertation, Greifswald, 1910.)—Two short antennæ are connected to the sides of a spark-gap of a condenser circuit and stretched out parallel to each other. It is then found by means of a resonance arrangement that, in addition to the two fundamental oscillations of the condenser circuit and the antennæ circuit, a very slightly damped oscillation is present. This is due to the quenching of the spark before all the energy of charge is dissipated. The circuit of the slightly damped oscillation is made up of the capacity between the ends of the antennæ, the antennæ and the wire parts of the condenser circuit, and the condenser itself. If the antennæ circuit and the condenser circuit are nearly in resonance and not too loosely coupled, the slightly damped oscillation is most intense, owing to the fact that the spark is periodically weakened by the interchange of energy between the two circuits, and is thus easily quenched. The effect is greatly increased if the spark is very small and weak (hissing spark). A large variation of frequency is obtained with the same condenser circuit by altering the length of the antennæ. **G. Seibt.** (Ibid. 35. pp. 191–192.) Seibt points out that the method has been described in his German Patent application of April 1, 1910. T. P. B.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

783. *Resistance Tests of Insulators at High Temperatures.* **W. W. Stifler.** (Phys. Rev. 32, pp. 429–432, April, 1911.)—Nickel wires are clamped to the sample and wound round it (asbestos, mica, sodium silicate, and liquid porcelain or cæmentium), or nickel wires are dipped into the quartz tube containing the paste of the magnesium oxide and alcohol of Terry [see Abstract No. 614 (1910)]. The sample is placed in a horizontal Pt-resistance furnace; the resistance is determined with the aid of a decade testing set, and the temperature, up to 1100° C., by means of a Pt-resistance thermometer and a Whipple indicator. Asbestos turns brittle; its insulating power breaks down at 900°, but is recovered on cooling. Mica insulates up to 1000° and breaks down very rapidly then, likewise turning brittle and opaque; on cooling the insulating power is recovered slowly down to 700°, and rapidly below this temperature. Magnesium oxide insulates well up to 800° and recovers on cooling. Sodium silicate breaks down above 200°. Cæmentium behaves irregularly; heating up to 1000° seems to improve the insulating power, but the material cannot be relied upon much above 500° C. H. B.

784. *Capillary Electrical Phenomena in Fluid Melts.* **G. v. Hevesy** and **R. Lorenz.** (Zeitschr. Phys. Chem. 74. 4. pp. 443–465, 1910.)—The capillary electrical phenomena in molten salts were investigated, employing a modified Lippmann electrometer. The apparatus was heated by an electric furnace,

cross-shaped, the electrometer being placed in one limb, and the changes which took place observed through the limb at right angles to the former. The salts used as fluid melts were $PbCl_2$, $CdCl_2$, KCl, KI, NaI, NaCl, LiCl, $SnCl_2$, $NaNO_3$, and $LiNO_3$, and the metals were Pb, Cd, Sn, Bi. The chief results obtained are: (1) A system composed of a metal and its fused halogen salts, such as lead and lead chloride, shows no capillary electrical phenomenon. (2) The system lead/potassium chloride behaved in a similar way to a capillary electrometer, constructed in the usual way with aqueous solution. The electrometers constructed thus: Pb/KCl, Pb/KCl, KI, Pb/NaI, NaCl, Sn/LiCl, KCl, Hg/$LiNO_3$, KNO_3, give electro-capillary curves having a rising and a falling branch. (3) The maximum of the curve given by lead in different electrolytes at different temperatures is practically in the same position. (4) The capillary electrometers with fused salts have about 1/1000 of the delicacy of the mercury-sulphuric acid combination. The low sensitiveness is due to the great depolarisation which takes place at the high temperature. The sensitiveness of the systems Hg/alkaline earth chloride in pyridine and Hg/KCl in fused $SbCl_3$ were determined. From the difference in sensibility of the two systems, Pb/KCl and Pb/KCl $PbCl_2$, the equilibrium concentration of the reaction $Pb^{\cdot} + 2KCl \rightleftarrows PbCl_2 + K^{\cdot}$ was calculated. F. J. B.

785. *Method of determining Capacities in Measurements of Ionisation.* **N. Campbell.** (Phil. Mag. 21. pp. 42–45, Jan., 1911.)—The difficulty of the ordinary method of measuring capacities such as those of electrometers and ionisation chambers lies in the choice of a suitable standard condenser with which to compare them. In the present paper the author describes a method in which the standard condenser made use of can be very large, of the order 0·1 mfd., thus eliminating the error due to the capacities of the conductors used for the various connections. For details of the method the original paper must be consulted. E. M.

786. *The Range of Power in Mirror Reading.* **W. Volkmann.** (Phys. Zeitschr. 12. pp. 80–82, Jan. 1, 1911.)—In order to increase the sensitiveness of a galvanometer the size of the mirror should be decreased as much as possible. There is, however, a limit to the extent to which we can do this on account of the decrease in the resolving power of the mirror. The author refers to the theory underlying the problem, and describes some experiments which he has performed to test it. A millimetre scale, illuminated by sunlight, is placed at a distance of 8 m. from a telescope, before which is placed a rectangular aperture. By means of a photographic apparatus placed behind the telescope the appearance of the divisions are photographed. The widening of the lines of the scale increases as the width of the slit is decreased until they are indistinguishable for a slit width of about 2·5 mm. This is in agreement with theory. However, it is advisable to have the scale at a distance not greater than 1 m. for every 2 mm. width of the mirror. W. C. S. P.

ALTERNATING CURRENTS AND MAGNETISM.

787. *Iron and its Alloys in Intense Magnetic Fields.* **R. A. Hadfield and B. Hopkinson.** (Inst. Elect. Engin., Journ. 46. pp. 235–284; Discussion, pp. 285–306, April, 1911. Electrician, 66. pp. 324–326, Dec. 9; and

Discussion, pp. 382–384, Dec. 16, 1910. Abstract.)—The paper describes tests by the isthmus method on iron and its alloys with Al, Si, Mn, Cr, Ni, W, and Cu. The following are the chief results: (1) Every alloy examined, without exception, has a definite saturation intensity of magnetisation. In most cases this is reached in a field of 5000 units, but in a few there is a small increase as between 5000 and 25,000. The forms of the curves of magnetisation connecting I and H in these exceptional materials, however, leave no doubt of the existence in them also of a saturation value of I. Every one of the materials tested, without exception, behaves as though it consisted of a mixture of magnetic substances with non-magnetic substances having a permeability not differing materially from unity. This holds good also for the non-magnetic or nearly non-magnetic Ni or Mn alloys, and in this respect the results differ from those obtained by Ewing and Low. Among all the alloys tested there is none having a constant permeability differing from unity by more than 2 per cent. (2) There is in the series no alloy having a higher specific magnetism than pure iron. (3) The saturation value of I in absolute units for pure iron of density 7·80 is 1680 within 1 per cent. (4) In an annealed iron-carbon steel in which other elements are present in small proportions the specific magnetism is less than that of pure iron by a percentage equal to six times the percentage of carbon. (5) Quenching an iron-carbon alloy from a high temperature reduces the specific magnetism by a large but somewhat uncertain amount. (6) The addition of Si or Al to iron results in a reduction in specific magnetism which is roughly in proportion to the amount added as though the addition behaved as an inert diluent. If carbon be present, however, Si seems to neutralise its action to some extent. For instance, an alloy containing 2·28 per cent. Si and 0·67 per cent. C. is 3·6 per cent. less magnetic than pure iron, whereas if the carbon had its full effect as in iron-carbon alloys, and the Si were simply an alert diluent, the reduction would be 6·3 per cent. (7) The observations on the alloys of Fe with Ni and with Mn, or with both these elements, have failed to reveal any simple relation between their magnetism and their composition. It is probable that this is due to the peculiar effects of heat-treatment on those substances. A. D. R.

788. *Mechanical Stress and Magnetisation of Nickel.* **W. Brown.** (Roy. Dublin Soc., Proc. 13. 3. pp. 28–48, April, 1911.)—An account is given of the continuation of experiments already described [Abstract No. 279 (1911)], by which it was shown that when a nickel wire was subjected to simultaneous longitudinal and circular magnetism the max. twist of the free end of the wire was greater the greater the longitudinal load. In the new experiments the same and higher loads were employed, as well as higher longitudinal magnetic fields, and the results are given in tables and curves. From these it is seen that the max. twist attains its highest value when the longitudinal load on the wire is at the rate of 4×10^5 gm. per cm.^{2}, and for the two higher loads used the max. twist is about the same or slightly diminished. Experiments were also made on the subsidence of torsional vibrations in nickel and iron wires when subjected to the action of longitudinal magnetic fields. The curves obtained show that in the case of Ni the greatest damping of the torsional oscillations takes place in each case when the wire is surrounded by a longitudinal magnetic field of the same value as was round the wire when the max. twist for the given load was obtained. Iron wires were also tested, and the general results were similar. This magnetic field, in the case of iron wires, is independent of the magnitude of the load on the wire, but increases

as the diam. of the wire is increased, and for the sizes of wires used it is also the magnetic field in which the max. transient current was obtained when the wire was mechanically twisted. With Ni wire this field increases as the load on the wire is increased, but is independent of the diam. of the wire. The influence of the initial amplitude of oscillation on the rates of subsidence of a wire magnetised longitudinally was also investigated. The greater the initial amplitude the lower is the longitudinal magnetic field in which the max. internal friction in the wire takes place. J. J. S.

789. *Magnetism of Iron in very Low Fields.* **W. Kummer.** (Elektrotechn. Zeitschr. 32. pp. 380–381, April 13, 1911.)—The author calls in question the even approximate accuracy of the usual Steinmetz formula, $W = \eta . B^{1·6}$, for connecting hysteresis loss with the max. induction obtained in iron. For very low fields he finds that the relation $W = 0·0000168 \times B^3$ is fulfilled with comparatively high accuracy. A. D. R.

790. *The Joule- and Wiedemann-effects in Steel Tubes.* **S. R. Williams.** (Phys. Rev. 32. pp. 281–296, March, 1911.)—The Joule and Wiedemann magnetostrictive effects were studied in the same samples of steel tubing. Under the latter effect the cases were studied in which the current was sent along an insulated wire inside the tube and also when the tube itself was used as a conductor; the effect was greater in the former case. The specimens were thin, narrow tubes of low-carbon steel about 80 cm. long. The lengthening in the Joule-effect was measured by a system of levers; the twist observed in the Wiedemann-effect had a max. value of 500 seconds of arc. The permeability of the tubes was determined by the ballistic method, and curves are given showing the change in length, the twist and permeability of the four tubes tested in fields from zero to 275 c.g.s. Apparently the permeability is the only property of the tubes which gives a decided colour to the character of the curves of twist and lengthening; the permeability appears to influence the twist more than the lengthening. G. E. A.

791. *The Magnéton in Solid Paramagnetic Substances.* **P. Weiss.** (Comptes Rendus, 152. pp. 688–691, March 13, 1911.)—The author has shown that the same common aliquot part—the "magnéton-gramme"—which is found in the saturation intensities of the magnetic metals at very low temperatures, is also to be obtained from observations on dilute paramagnetic solutions [see Abstract No. 677 (1911)]. In the present paper he shows that the same laws hold in the case of solid paramagnetic compounds. Results are given which have been obtained from the oxides of certain rare earths and from the common salts of Fe, Cr, Mn, &c. A. D. R.

792. *Propagation of Magnetic Waves in an Iron Bar.* **C. V. Drysdale.** (Electrician, 67. pp. 95–96, April 28, 1911.)—The distribution of magnetic flux in an iron bar, magnetised at one end by a coil fed with alternating current, was determined by means of a search coil and potentiometer [see Abstract No. 449B (1909)]. The bar was of wrought iron, and was 258 cm. long; the magnetising coil had 50 turns, and 2·4 effective amps. were passed through it. By comparison of expressions it is shown that the magnetised bar is the analogue of a current-carrying cable in which the resistance corresponds to the reciprocal of the permeability, the inductance to the eddy-current coefficient, the leakance to the dispersion coefficient, and which has no capacity. The experimental results confirm this analogy. [See also Abstract No. 280B (1908).] G. E. A.

793. *Magnetism of some Complex Salts.* **Mlle. E. Feytis.** (Comptes Rendus, 152. pp. 708–711, March 13, 1911.)—The magnetic susceptibilities of a large number of complex salts of Fe, Cr, Co, and Pt have been determined, employing a Curie balance, and examining the solid crystals. Strongly magnetic bodies were compared with a solution of nickel nitrate, and feebly magnetic ones with water. No well-marked difference exists between normal and complex salts, all possible transitions between the coefficients of magnetisation of these two classes of bodies being met with. Substitution of an atom of Cl for a molecule of ammonia in the complex ion $Co(NH_3)_6$ diminishes its diamagnetism, whilst two atoms of Cl reduce it still further, but the introduction of a molecule of water instead of a molecule of ammonia has less effect than that of a negative ion. W. H. Si.

794. *Magneto-chemical Researches on the Atomic Structure of the Halogens.* **P. Pascal.** (Comptes Rendus, 152. pp. 862–865, March 27, 1911.)—Excluding the derivatives of fluorine, halogen compounds may be divided into two distinct groups: (1) those in which the Cl, Br and I, retain their normal magnetic properties, and (2) those, which may be termed abnormal, which are always much less diamagnetic than would correspond to the magnetic susceptibilities of their components. The depression D, of the diamagnetism, and the experimental molecular susceptibilities, S, are given for thirty halogen compounds of the latter class, and by plotting the values of D as ordinates, and the weights of the corresponding halogen groups as abscissæ, the points of intersection lie upon straight lines passing through the origin, and the angular coefficient λ measures the loss of specific susceptibility for each atom of the halogen group. The observed values of λ are found to be multiples of $0{\cdot}2468 \times 10^{-7}$, containing this factor respectively 1, 2, 3, 4, 5, 6, 10, 11, 14, and 16 times, whilst the susceptibilities of Cl, Br, and I contain this factor respectively 24, 16, and 15 times. These results suggest the splitting-up of the diamagnetic atom of a halogen into smaller identical elements, of which the number varies from one halogen to another, and it is hoped that magneto-chemical analysis will enable a diamagnetic atom to be deduced similar to the paramagnetic atom proposed by Weiss. W. H. Si.

795. *Earth Currents and Magnetic Disturbances.* **J. Bosler.** (Comptes Rendus, 152. pp. 842–845, Feb. 6, 1911.)—The author gives a short discussion of the interdependence of magnetic storms and earth currents, of which we are at present in some doubt as to which is cause and which is effect. With the idea of the variations of earth currents being the precursors of the magnetic storms, a series of values of each, obtained from Parc St. Maur and Greenwich are plotted. From the traces it is evident that they are decidedly interdependent, and more work is advisable to render the examination more complete. C. P. B.

796. *Time Accuracy in Magnetic Registration.* **G. van Dijk.** (Nature, 86. p. 44, March 9, 1911.)—Referring to previous correspondence [Abstracts Nos. 1337, 1338, 1339 (1910)] by Bauer and Faris, Walker and Krogness, concerning the accuracy attainable in the measurement of magnetograph traces, it is pointed out that the arrangements of rapid registration and time marks on the trace have been carried on for some time past at the De Bilt

Meteorological Institute. By means of a contact clock, the circuit of a battery is closed for 2 sec. every minute; the current illuminates a small glow-lamp, the filament of which is straight and placed vertically. This filament takes the place of the illuminated slit in the usual arrangement of the Adie magnetograph; its image, about ¼ mm. wide, would be formed in the plane of the paper. Just in front of the paper, however, a screen with narrow horizontal slit is mounted; and thus only the light admitted through the slit falls on the paper, and we get a little line or spot about ⅓ mm. long and ⅛ mm. wide. Every minute such a spot is formed. Another contact lights the glow-lamp for 4 sec. every 20 minutes, this falling between two of the minute contacts. The moments of the 20-minute contacts are at 0m., 20m., 40 m., Greenwich mean time. Thus the beginning of a disturbance is known to about ¼ minute. C. P. B.

797. *Measurement of Magnetic Susceptibility.* **C. E. Mendenhall** and **W. F. Lent.** (Phys. Rev. 32. pp. 406–417, April, 1911.)—A null method for measuring magnetic susceptibility is described and its accuracy discussed. The principle of the method is, briefly, to balance the torque produced by the action of a non-uniform magnetic field upon two symmetrically-placed specimens of the substance under test, by the torque due to the action of the same field upon coils immediately surrounding the specimens, the current in which can be measured. The mean value of the susceptibility obtained for pure bismuth is K = 14·32. Preliminary results on the effect of heat-treatment (crystal structure) on the susceptibility of Bi are given. The curves connecting K and percentage composition for the series of Bi-Te alloys is given, showing no peculiar magnetic properties for the compound Bi_2Te_3. The corresponding curve for Bi-Tl alloys is also determined and does show peculiar magnetic properties for the compound Bi_5Tl_3. J. J. S.

REFERENCES.

798. *Thermodynamics of Magnetostriction.* **A. Leduc.** (Comptes Rendus 152. pp. 853–855, March 27, 1911.)—Criticises the expression for the increment of heat recently used by Houstoun [see Abstract No. 675 (1911)]. E. H. B.

799. *Salt Solution in Non-homogeneous Magnetic Field.* **W. Voigt.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 6. pp. 545–553, 1910.)—The change of density of a gas in an electric field of variable intensity has been observed by Gans [see Abstract No. 1505 (1904)]. The above paper deals with the analogous case in magnetism, and the change of concentration of a solution of $FeCl_3$ caused by a magnetic field was determined theoretically and by experiment. The experimental results were obtained by measuring the change in the deviation of a ray on passing through the liquid when subjected to the action of the non-homogeneous magnetic field. They agree approximately with the result expected from the theory. G. E. A.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

800. *Behaviour of Solid and Liquid Copper towards Gases.* **A. Sieverts and W. Krumbhaar.** (Zeitschr. Phys. Chem. 74. 3. pp. 277–307, 1910.)—The authors have investigated fully the behaviour of various gases on liquid and solid copper, and have come to the following conclusions: (1) Oxygen is dissolved by molten copper in the cuprous state and is not given off on solidification even in an oxygen-free atmosphere. (2) Nitrogen and CO_2 are not absorbed either by solid or liquid copper, nor has CO any effect. (3) Solid copper absorbs hydrogen, as already proved, and full particulars are given for which the paper should be consulted. (4) Solid copper does not absorb SO_2, but the molten metal does so to a considerable extent. O. J. S.

801. *Influence of Manganese on Mild Steel.* **G. Lang.** (Metallurgie, 8. pp. 15–21, Jan. 8, and pp. 49–58, Jan. 22, 1911.)—The literature of the influence of Mn on the properties of iron shows a lack of agreement amongst the various results, which the author ascribes partly to the variation in carbon-content brought about by introducing the Mn in the form of ferromanganese. By the use of electro mild-steel and thermite manganese, the author has prepared a series of alloys containing about 0·1 per cent. carbon with Mn varying from 0·285 to 2·47 per cent., the other impurities being fairly constant. The alloys were sand cast in 100 × 100 mm. sections weighing about 85–100 kg., 50 per cent. cropped off to remove segregations, and the remainder rolled into round bars 30 mm. diam. Mechanical tests were made on the bars in the normal state, after annealing for 1 hour at 900° C., and after quenching from 900° C. in cold water. The results show that an addition of 0·1 per cent. Mn causes an increase of tenacity of 1·4 kg./mm.^{2} in the normal state, 1·6 in the annealed state, and 2·4 in the quenched state. Up to 1·5 per cent. Mn the elongation and contraction are practically constant, but beyond this a slight falling-off in ductility is noticed. Manganese increases the Brinell hardness-number, this being particularly noticed in the quenched samples. Up to 1·5 per cent. Mn, the resistance to impact is increased, but a decided falling-off is observed above this percentage. For magnetic and electrical tests the bars were rolled to 8 mm. diam., then turned to 6 mm. diam. and tested in the normal, quenched, and annealed states. Manganese increases the hysteresis and coercive force, but decreases the permeability and hardly affects the retentivity. Annealing decreases, while quenching increases the coercive force and hysteresis. The electrical resistance is gradually increased by the addition of Mn, but does not appear to be affected by heat treatment. The microstructure of a quenched 1 per cent. Mn alloy is partly martensitic, that of the 2 per cent. Mn steels wholly martensitic. F. C. A. H. L.

802. *Internal Structure of Pearlitic Steel.* **M. Oknof.** (Metallurgie, 8. pp. 188–189, March 8, 1911.)—By photographing the structures of repeatedly polished samples of pearlitic steel, thus revealing successive layers, the author has shown that the pearlite is continuous, with the ferrite or cementite distributed through it in grains. This confirms Osmond's "cellular theory" for the structure of steel. F. C. A. H. L.

803. *The Ovifaker Iron: A Natural Carbon Steel.* **C. Benedicks.** (Metallurgie, 8. pp. 65–68, Feb. 8, 1911. Paper read before the 11th Geological Congress, Stockholm, 1910.)—The author has examined the specimens of the natural mass of iron discovered by Nordenskiöld at Ovifaker, under the microscope, and the results show that the mass is a natural steel of high sulphur-content. The structure differs from that of meteoric iron in showing the presence of finely-divided pearlite, indicating very rapid cooling below 700° C. A new constituent has been observed, to which the author ascribes the name "oxide-pearlite," in which the cementite lamellæ appear to penetrate into the oxide; this oxide-pearlite has probably been formed by a secondary oxidation of the ferrite lamellæ in pearlite. The results confirm the view that the mass has been produced by the reduction of the iron compounds in molten basalt by some highly carbonaceous material.

F. C. A. H. L.

804. *Action of Ultra-violet Rays on Cyclic Organic Compounds and on Aqueous Solutions of Mineral Salts.* **D. Berthelot** and **H. Gaudechon.** (Comptes Rendus, 152. pp. 376–378, Feb. 13, 1911.)—While the ultra-violet rays decompose organic compounds of a simple chain-structure (aliphatic compounds) under liberation of gas, they do not attack the closed ring-structures of aromatic compounds, benzene, phenols, aldehydes, mono- to hexa-basic acids; in some cases polymerisation is observed. Nor are other compounds with closed ring-structures attacked, pyrrole (pentagon of C and N), pyridine (hexagon of C and N), nicotine, caffeine, &c. When the rings are combined with lateral chains (cinnamic acid), a very slow decomposition and gas generation is observed. Pure aqueous solutions of metallic salts (gold chloride, silver nitrate, copper sulphate) remain limpid when exposed to ultra-violet rays. Nickel sulphate becomes turbid in the presence of traces of iron. Iron sulphate turns turbid, and some basic sulphate is apparently precipitated; in the presence of acids it also remains limpid. H. B.

805. *Relation of Osmotic Pressure to Temperature.* I. *Manufacture of Cells.* **H. N. Morse, W. W. Holland, J. C. W. Frazer,** and **B. Mears.** (Amer. Chem. Journ. 45. pp. 91–118, Feb., 1911.) II. *The Manometers.* **H. N. Morse, W. W. Holland,** and **J. L. Carpenter.** (Ibid. pp. 237–268, March, 1911.)—A very interesting account is given of the experimental difficulties that had to be overcome in making accurate measurements of osmotic pressure. One of the most difficult problems was to secure satisfactory cells, and these were finally manufactured in the laboratory by a process the chief features of which were: (1) to mix two clays, one with an excess and the other with a deficiency of binding material, instead of attempting to mix clay and feldspar, and (2) to press the clay into a cylinder and cut the cells from this on a lathe in order to get rid of "air blisters." A detailed description is also given of the methods used in preparing, fixing, and calibrating the manometers. This can only be consulted with advantage in the original, and no abstract need therefore be attempted. T. M. L.

806. *Rise of Boiling-point at Diminished Pressures.* **K. Drucker.** (Zeitschr. Phys. Chem. 75. 5. pp. 612–618, 1910.)—The Beckmann apparatus for determining molecular weights by rise of boiling-point was adapted so as to be capable of use at lower pressures. The boiling tube was heated by an electrical heating coil, and the condenser, side tube, and thermometer were

all fitted with well-ground glass joints. The apparatus was then connected with an arrangement for keeping the pressure constant. This consisted of a large glass vessel, of 8 litres' capacity, and a manometer, which were connected with a pump. The pressure was regulated by means of an electromagnetic regulator, the circuit being completed when the pressure fell below a certain point, whereby the iron cores became magnetised and opened a valve which admitted air. When the pressure rose again the circuit was broken, the cores demagnetised, and the valve closed. In this way the pressure could be kept constant to a few tenths of 1 mm. The apparatus was tested with benzene, chloroform, and ethyl alcohol as solvents, and camphor as dissolved substance; a good agreement found between the values attained by this method and those found in the usual manner.

F. J. B.

807. *Remark on the Law of Eötvös.* **A. Einstein.** (Ann. d. Physik, 34. 1. pp. 165–169, Dec. 30, 1910.)—From the law of Eötvös $\gamma v^{2/3} = k(\tau - T)$, combined with Trouton's rule and the rule of corresponding states, the author derives the expression $U_r/U_l = k$, where U_r is the energy necessary to produce an increase in the surface equal to the area of the side of the gm.-molecule cube, and U_l is the internal energy of vaporisation of a gm.-molecule. Assuming that the radius of the sphere of action of the molecules is large compared with the molecules, but equal for molecules of different kinds, and also that a molecule is acted on only by those adjacent to it and not by those farther removed, the author calculates the value of U_r/U_l to be 8×10^{-9}. From experimental numbers for mercury and benzene, the author calculates, on the basis of a derived equation, the values of U_r/U_l at $5·18 \times 10^{-9}$ and $5·81 \times 10^{-9}$, in harmony, therefore, with that previously calculated from a universal equation.

A. F.

808. *Effects of Ultra-violet Radiations.* **A. Guntz and J. Minguin.** (Comptes Rendus, 152. pp. 372–373, Feb. 13, 1911.)—The effects of radiations from a mercury vapour lamp (silica Westinghouse, 3·5 amps. at 220 volts) are studied. The surface of crystals of benzylidene camphor are corroded, but the melting-point and $[\alpha]_D$ remain constant. Sugar-candy crystals are also corroded, the candy turning yellow, and a certain amount of glucose being produced; glucose and lævulose are also formed by the action of the rays on cane-sugar in solution. Anthracene, in benzene solution, polymerises into *p*-anthracene; while phosphorus under water quickly becomes red; crystalline sulphur is reduced to powder, and solutions of sulphur in carbon disulphide or benzene deposit an insoluble modification of sulphur.

W. H. Si.

809. *Adsorption of Solutions.* **G. C. Schmidt.** (Zeitschr. Phys. Chem. 74. 6. pp. 689–737, 1910.)—As the result of experiments with cane-sugar charcoal and solutions of iodine in chloroform and in alcohol, and also with animal charcoal and alumina as the adsorbing agents and solutions of iodine in alcohol, it is shown the Kroeker's law holds, according to which the mass of the solvent in dilute solution is constant. Further experiments with animal charcoal and a specially pure cane-sugar charcoal as the adsorbents, and solutions of acetic acid in water and iodine in benzene, furnished a proof of the adsorption isotherm of Freundlich. The rate at which equilibrium is established depends on the quality of the charcoal. At low temperatures the attainment of equilibrium takes place very slowly, whilst at high temperatures

the process is a rapid one. If, after equilibrium has been established, the solution is diluted, the new equilibrium is attained the more quickly the greater the alteration in concentration which has been brought about. If, however, a charcoal is treated with a concentrated solution after equilibrium has been established, the attainment of the new equilibrium takes place more slowly than on dilution. The influence of temperature on the equilibrium is very small; with rise in temperature the quantity absorbed diminishes. A new adsorption isotherm is deduced, of the form $\log_e [S/(S-x)]-Ax=C(a/v)$, where S is the max. adsorption, x the quantity absorbed, a the total quantity of solute, v the volume, and A and C are constants depending on the quantity of charcoal used. From further observations on the adsorption by charcoal of acetic acid and of iodine in ethyl acetate solution, it is shown that if charcoal is in contact with a solution containing two substances A and B, it adsorbs less of each of these substances than it would from solutions of each of these substances of the same concentration. If charcoal is in equilibrium with a solution of A, and some of B is added to the solution, then B replaces some of A in the charcoal, and *vice versâ.* The total quantity adsorbed when two substances are together in solution is not the sum of the quantities adsorbed from pure solutions of each of the substances, under the same conditions of concentration, but always less. T. S. P.

810. *Ozone Formation by the Silent Discharge.* **A. W. Ewell.** (Phys. Rev. 32. p. 215, Feb., 1911.)—Kabakjian found the yield of ozone per coulomb practically independent of the current density [see Abstract No. 1484 (1910)]. This does not agree with the author's observations [compare Abstracts Nos. 1147 (1906) and 695 (1907)]; but the experimental conditions were different, both the current densities and polar distances being larger in the author's experiments. The e.m.f. plotted by Kabakjian is, moreover, not the actual e.m.f. impressed upon the gas. H. B.

811. *New Proof of the Actual Existence of Molecules.* IV. **T. Svedberg** and **N. Pihlblad.** (Zeitschr. Phys. Chem. 74. 5. pp. 513–536, 1910.)—Experiments are described on the absorptive power for light of different wavelengths of colloidal solutions of gold, selenium, and indigo. In nearly every case the absorptive power was found to reach a maximum at a point in the visible spectrum between $\lambda = 550$ and $600\,\mu\mu$. The absorptive power of a given weight of suspended colloid also attains a max. value as the size of the particles is reduced and their number increased, but the absorption produced by each particle decreases steadily as its size is reduced.

T. M. L.

812. *Precipitation of Metals from Aqueous Solutions of their Salts at High Pressures.* **W. N. Ipatiev** and **W. Werchowskij.** (Ber. Deut. Chem. Gesell. 42. pp. 2078–2088, 1909.)—The experiments of Nernst and Tammann (1892) on the reduction of dissolved salts to the state of metal by hydrogen under pressure gave negative results. The authors employ an apparatus used for organic reductions under high pressure, by means of which pressures up to 600 atmos. may be obtained. Under 200 atmos., silver and mercury are precipitated even from N/10 solution at the ordinary temperature. Copper is, however, not precipitated even under 500 atmos. Cupric salts deposit at 60–70° cuprous oxide in the form of carmine-red crystals; above 90° the product is a mixture of cuprous oxide and Cu, and above 120° it consists of pure Cu in branched crystals. A pressure of 100 atmos. is sufficient,

but precipitation does not occur under atmospheric pressure. Nickel, Co, Pb, and Bi are similarly precipitated at a high temperature, Ni completely at 200° under 180 atmos. Ferric acetate at 350° under 280 atmos. deposits the whole of its iron as anhydrous red ferric oxide. At 400° under 420 atmos. a small quantity of metallic iron was also found, but each experiment only lasted a few minutes, owing to the bursting of the steel tubes. L. H. W.

813. *Some General Characteristics of Binary Equilibrium Diagrams.* **K. Bornemann.** (Metallurgie, 7. pp. 740–747, Dec. 8, 1910.)—The theory of dilute solutions shows that perfect immiscibility of two bodies is impossible, and from this the author deduces that in all binary systems under constant pressure, no phase is limited to one concentration at a particular temperature, but has a certain definite range of composition. Applied to various types of diagrams this principle clears up certain difficulties, and with a slight modification has been useful in explaining certain complicated changes occurring in the Ni-S system [see Abstract No 409 (1910)]. Similarly the heterogeneous fields can have, at no temperature, an infinitely small range of composition. These properties of the equilibrium diagram are in accord with the principles of thermodynamics.

F. C. A. H L.

814. *Electrolytic Conductivity of Non-aqueous Solutions at Low Temperatures.* **P. Walden.** (Zeitschr. Phys. Chem. 78. 3. pp. 257–268, 1910.)—Measurements of electrical conductivity made at ordinary temperatures indicate that the conductivity-temperature curves would converge on to the axis of zero conductivity at a definite temperature (—39° C. for water) depending on the form of the fluidity-temperature curve, which also tends towards a zero value at this temperature. It has been pointed out, both on the theoretical and on the experimental side, that this convergence is probably imaginary, and that the actual curves would turn aside and become asymptotic to the axis of temperature instead of intersecting it. Kunz, in particular, found that aqueous solutions cooled to —74° still possessed appreciable conductivity. The author has investigated the same point on the following twelve solvents :—

	Freezing-point.	Temperature-coefficient.	Convergence Temperature.
Methyl alcohol	— 94·9°	0·0157	—64°
Ethyl alcohol	—112	0·0227	—44
Glycol	— 11·2	0·094	—10·7
Acetone	— 95	0·0102	—98
Furfurol	— 36·5	0·0245	—40
Anisaldehyde	— 2·1	0·061	—16
Lactonitrile......................	—	0·032	—31
Methyl cyanacetate	— 22·5	0·044	—23
Propionitrile	—108·5	0·112	—89
Benzylcyanide	— 26·5	0·0298	—32·5
Methylsulphocyanide	— 51	0·0148	—68
Nitromethane..................	— 26·5	0·0184	—75

Using tetraethylammonium iodide, $N(C_2H_5)_4I$, as solvent in every case, it was found that electrical conductivity persisted down to —112°, the lowest temperature used, or to the temperature at which the liquid began to crystallise : no break was found at the freezing-point in the conductivity-temperature curves, and in seven of the twelve cases the curves passed smoothly through the convergence-temperature at which—if the conventional extrapolation formulæ were reliable—the conductivity should vanish. All the curves were found to turn round in such a way as to approach asymptotically towards the line of zero conductivity instead of intersecting it. T. M. L.

815. *Theory of the Opalescence of Homogeneous Liquids and Liquid Mixtures in the Neighbourhood of the Critical State.* **A. Einstein.** (Ann. d. Physik, 33. 6. pp. 1275–1298, Dec. 20, 1910.)—Smoluchowski has shown that the opalescence of liquids in the neighbourhood of the critical state and of mixtures in the neighbourhood of the critical solution point can be readily explained on the basis of the molecular theory of heat [see Abstract No. 1587 (1908)]. He gave, however, no exact calculation of the amount of light given off laterally by the opalescence. The author now fills this gap. He first of all obtains, on the basis of Boltzmann's principle, the statistical law according to which the density of a homogeneous substance or the mixture proportions of a mixture varies with the position, and then calculates the light refracted from an absorption-free medium of infinitely slight inhomogeneity. One of the chief results obtained is a formula by means of which an exact determination of the absolute magnitude of the molecule is possible. The case of a homogeneous substance is then considered, and the author shows that the formula which is obtained is capable of explaining the predominantly blue light emitted from the atmosphere. A. F.

816. *Exact Electrolytic Method for determining Metals.* **W. L. Perdue** and **G. A. Hulett.** (Journ. Phys. Chem. 15. pp. 147–154, Feb., 1911.)—The occlusion of electrolyte in the deposited metal often causes considerable errors in electro-analysis. Mercury and its liquid amalgams possess the great advantage of not occluding any electrolyte, and hence the use of mercury as a kathode; when, however, electro-analyses are carried out according to the method of Kollock and Smith, some of the liquid percolates between the mercury and the walls of the containing vessel and thus causes an error. The authors obviate this error by using an amalgamated Pt crucible to contain the mercury kathode and obtain very satisfactory results in the determination of cadmium, using stationary electrodes. Metals which are not very soluble in mercury soon give rise to a solid amalgam which floats on the surface of the mercury; the metal grows up and away from the mercury, and may include some of the electrolyte. This can be prevented by rotating the crucible containing the mercury, and the authors show that good results are obtained in the determination of copper and zinc; the average error is about 1 in 4000. [See Abstract No. 982 (1907).] T. S. P.

817. *Electrolytic Determination of Zinc in Ores.* **G. Kemmerer.** (Journ. of Industrial and Engineering Chemistry, 2. No. 9; Chem. News, 103. pp. 174–175, April 13, 1911. Abstract.)—According to the authors, zinc can be determined accurately by electrolytic methods when the electrolyte contains 20–25 gm. of sodium hydroxide per 100–150 c.cm. (?), using a current density of 8·1 amps./dm.^{2}, a nickel gauze kathode and a rotating anode. The deposits obtained were all a beautiful bluish white, and in every case the resulting solution showed no zinc present by the ferrocyanide test. 0·17–0·87 gm. of zinc were deposited in 10–20 minutes. [See Abstract No. 778 (1910).] T. S. P.

SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JULY 1911.

CONTENTS.

GENERAL PHYSICS.

PAGE
818. Silver Disc Pyrheliometer. *C. G. Abbot* ... 289
819. Determining Elastic Limits. *O. Faust & G. Tammann* ... 289
820. Testing Copper Alloys. *L. Révillon* ... 290
821. Permanent Deformation of Stretched Metals. *L. Hartmann* ... 290
822. Brownian Movement of Particles. *S. Lifschitz* ... 292
823. Capillary Phenomena. *S. L. Bigelow & F. W. Hunter* ... 292
824. Coefficient of Transmission of Atmosphere. *O. v. Myrbach-Rheinfeld* ... 293
825. Seiches in Windermere. *G. Dobson* ... 293
826. Solar Constant. *C. G. Abbot & F. E. Fowle, Jr.* ... 293
827. Periodicity of Sun-spots. *A. Schuster* ... 293
828. Temperature of the Sun. *F. Kurlbaum* ... 294
829. Comet Photometry. *H. K. Shaw* ... 294
830. Selective Absorption of Atmosphere. *C. Galissot* ... 294
831. Equatorial Current of Jupiter in 1880. *A. S. Williams* ... 294
832. Theory of Motion of Jupiter and Saturn. *R. T. A. Innes* ... 294
833. Dark Band surrounding Polar Caps of Mars. *E. M. Antoniadi* ... 294
834. Radiation Pressure applied to Cosmic Problems. *A. F. & F. A. Lindemann* 294
835. Absorption of Light by Meteorites. *Salet* ... 295
836. Spectra of Nebulæ. *C. Fabry & H. Buisson* ... 295
837. Spectrum of Red Star in Lacerta. *T. E. Espin* ... 295
838. Proper Motion of Small Star. *S. W. Burnham* ... 296
839. Intrinsic Light of Algol System. *C. Nordmann* ... 296
840. Variation of Light of S Aræ. *A. W. Roberts* ... 296
841–858. References ... 296

LIGHT.

859. Monochromator. *H. du Bois & G. J. Elias* ... 298
860. Double Refraction of Caoutchouc. *P. Rossi* ... 298
861. Speed of Light in Refracting Media. *Gutton* ... 298

PAGE
862. Refraction in Gases CO_2, CO, and C_3O_2. *G. Gruschke* 298
863. Optical Dispersion. *T. H. Havelock* 298
864. Dispersive Power of Prism Combinations. *G. Meslin* 299
865. Opacity of Glasses for Ultra-violet. *L. Bell* 300
866. Long-waved Radiation of Mercury Vapour. *H. Rubens & O. v. Baeyer* ... 300
867. Visual Inhibition with Stereoscope. *A. Chauveau* 301
868. Dispersion in Vapours of Alkali Metals. *P. V. Bevan* 301
869. Absorption Spectra of Lithium and Cæsium. *P. V. Bevan* 302
870. Variations of Spectra with Current and Pressure. *P. G. Nutting & O. Tugman* 302
871. Effect of Pressure upon Arc Spectra. *W. G. Duffield* 303
872. Pressure Displacement of Spectral Lines. *R. Rossi* 304
873. Structure of Spectral Lines. *H. Brotherus* 304
874. Spectrum of Poulsen Arc. *E. O'Connor* 304
875. Spectra of Gases in Extreme Ultra-violet. *T. Lyman* 305
876. Spectrum of Carbon. *M. La Rosa* 305
877. Argon Spectra. *W. Stahl* 305
878. Zeeman-effect in Weak Fields. *H. Lunelund* 305
879. Zeeman-effect for Chromium. *H. D. Babcock* 306
880. Destruction of Fluorescence of Iodine Vapour. *R. W. Wood* 306
881. Kathode Luminescence in Minerals. *A. Pochettino* 307
882. Rays from the Alkaline Metals. *E. Henriot* 307
883. Secondary Röntgen Rays (Sagnac's Rays). *H. Guilleminot* 308
884. Polarisation of Röntgen Rays from Silver Antikathode. *F. C. Miller* 308
885. Scattering during Radio-active Recoil. *W. Makower & S. Russ* 309
886. Excited Radio-activity. *E. Sarasin & T. Tommasina* 309
887. Radio-activity of Thorium. *E. Rutherford* 309
888. Th AC. *A. S. Russell & F. Soddy* 310
889. Ionisation by α-Particles. *T. S. Taylor* 310
890. Range of α-Particles of Uranium. *A. Foch* 311
891. Absorption Coefficient of Iron for γ-Rays. *W. Wilson* 311
892–898. References 311

HEAT.

899. Molecular Heat Conductivity of Gases. *M. Knudsen* 312
900. Theory of Specific Heat. *W. Nernst* 313
901. Mechanism of Flame: Convergent Combustion. *J. Meunier* 313
902. Determining Heat of Evaporation. *T. W. Richards & J. H. Mathews* ... 313
903–907. References 314

SOUND.

908. Experiments with the Gramophone. *J. G. McKendrick* 315
909. Gramophone. *C. A. Parsons* 315
910. Movement of Particles by Sound Waves. *W. König* 315
911–915. References 316

ELECTRICITY AND MAGNETISM.

916. Distribution of Electricity in Conductors. *E. Almansi* 317
917. Electrical Dispersion of Atmosphere. *G. Accolla* 318
918. Nuclei produced by Ultra-violet Light. *S. Sachs* 319
919. Velocity Dispersion of Canal Rays. *J. Kutschewski* 319
920. Transverse Currents in Luminous Discharge. *R. Reiger* 319
921. Kathodic Corpuscles; m as $f(v)$. *C. E. Guye & S. Ratnowsky* 319
922. Radiation emitted in Interior of Glow-lamps. *L. Houllevigue* 320
923. Sounds produced in Electric Discharges. *R. De Muynck* 321
924. Effect of Spark Extinction on Damping Determinations. *B. Macků* 321

PAGE
925. Decrement of a Condenser Circuit. *A. Petrowsky* 322
926. Sensitiveness of Selenium. *A. Pochettino* 322
927. Thermoelectric Properties of Molybdenum. *W. W. Coblentz* 322
928. Sensitiveness of Moving-coil Galvanometers. *E. Dibbern* 323
929. Electrical Properties of Alloys of Noble Metals. *W. Geibel* 323
930. Effects of Sudden Changes of Inductance. *B. O. Peirce* 324
931. Zinc Amalgams and the Clark Cell. *E. Cohen & P. J. H. van Ginneken* 324
932. Mercurous Sulphate and Standard Cells. *P. J. H. van Ginneken* 324
933. New Form of Earth Inductor. *J. E. Ives & S. J. Mauchly* 325
934. A.C. Resistance of Coils. I. *A. Esau* 325
935. A.C. Resistance of Coils. II. *A. Esau* 325
936. A.C. Resistance of Coils. III. *A. Esau* 326
937. Electromagnetic Effects in Soft Iron. *E. H. Hall & L. L. Campbell* 326
938. Magnetic Properties of Fluorine. *P. Pascal* 327
939. Origin of Magnetic Storms. *A. Schuster* 327
940. Wehnelt Interrupter in Radiography. *Marie & Durand* 327
941–956. References 328

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

957. Density of Niton ("Radium Emanation"). *R. W. Gray & W. Ramsay* 330
958. Separation of Ionium from Residues. *B. B. Boltwood* 330
959. Viscosity and Atomic Weight of Inert Gases. *A. O. Rankine* 330
960. Temperature Measurements in Carborundum Furnace. *H. W. Gillett* ... 331
961. Electric Smelting of Oxidic Ores. *W. Borchers* 331
962. Alteration of Aluminium. *H. Le Chatelier* 331
963. Adhesivity of Brown Gold. *Hanriot* 332
964. Metallic Titanium. *M. A. Hunter* 332
965. Amalgams containing Silver and Tin. *R. A. Joyner* 332
966. Occlusion of Hydrogen by Pd-Au. *A. J. Berry* 333
967. Gold-Tellurium Alloys. *M. Coste* 333
968. Ag-Cd Alloys. *G. J. Petrenko & A. S. Federow* 333
969. Decomposition of Calcium Carbide. *G. Erlwein C. Warth, & R. Beutner* 334
970. Precipitation of Free Carbon from Fe-C Alloys. *W. H. Hatfield* 334
971. Maximum Tension of Electrolytic Valve Cells. *G. Schulze* 335
972. Rapid Determination of Nickel and Cobalt. *R. C. Benner & W. H. Ross* 335
973. Accuracy of the Copper Voltameter. *L. Dede* 336
974–976. References 336

AUTHORS' INDEX.

Abbot, C. G., 818, 826.
Accolla, G., 917.
Almansi, E., 916.
Antoniadi, E. M., 833.
Babcock, H. D., 879.
v. Baeyer, O., 866.
Bell, L., 865.
Benner, R. C., 972.
Berry, A. J., 904, 966.
Beutner, R., 969.
Bevan, P. V., 868, 869.
Bigelow, S. L., 823.
du Bois, H., 859.
Boltwood, B. B., 958.
Borchers, W., 961.
Born, M., 893.
Brotherus, H., 873.
Buisson, H., 836.
Burnham, S. W., 838.
Burton, C. V., 858.
Campbell, L. L., 937.
Campbell, N., 849.
Campbell-Swinton, A. A., 949.
Chatelier, H. Le, 962.
Chauveau, A., 867.
Chree, C., 956.
Coblentz, W. W., 927.
Cohen, E., 931.
Coste, M., 967.
Dede, L., 973.
DeLeeuw, A. L., 846.
De Muynck, R., 923.
Dibbern, E., 928.
Dobson, G., 825.
Drecq, M., 905.
Duffield, W. G., 871.
Dunlap, K., 949.
Durand, 940.
Eagle, A., 897.
Ehrenhaft, F., 947.
Elias, G. J., 859.
Erlwein, G., 969.
Esau, A., 934, 935, 936.
Espin, T. E., 837.
Eve, A. S., 948.
Fabry, C., 836.
Faust, O., 819.
Federow, A. S., 968.
Fery, C., 905.
Fleming, J. A., 952.
Fletcher, H., 946.
Foch, A., 890.
Fowle, Jr., F. E., 826.
Frank, P., 851.
Galissot, C., 830.
Geibel, W., 929.
Gillett, H. W., 960.
van Ginneken, P. J. H., 931, 932.
Gray, R. W., 957.
Griffith, O. W., 894.
Grotrian, O., 955.
Gruschke, G., 862.
Guilleminot, H., 883.
Gutton, 861.
Guye, C. E., 921.
Hall, E. H., 937.
Hanriot, 963.
Hartmann, L., 821.
Hatfield, W. H., 970.
Havelock, T. H., 863.
Henriot, E., 882.
Hicks, W. M., 898.
Hoecken, K., 841.
Houllevigue, L., 922.
Hunter, F. W., 823.
Hunter, M. A., 964.
v. Ignatowsky, W., 844.
Innes, R. T. A., 832.
Ishiwara, J., 941, 942.
Ives, J. E., 933, 951.
Jorissen, W. P., 907.
Joyner, R. A., 965.
Jüttner, F., 848.
Knudsen, M., 899.
König, W., 910.
Kurlbaum, F., 828.
Kutschewski, J., 919.
Ladenburg, R., 893.
Lamb, H., 853.
La Rosa, M., 876.
Le Chatelier, H., 962.
Lifschitz, S., 822, 914.
Lindemann, A. F., 834.
Lindemann, F. A., 834.
Lunelund, H., 878.
Lux, H., 842.
Lyman, T., 875.
McClenahan, H., 843.
McKendrick, J. G., 908.
Macků, B., 924, 950.
Makower, W., 885.
Marie, 940.
Mathews, J. H., 902.
Mauchly, S. J., 933.
Meslin, G., 864.
Meunier, J., 901.
Michaud, F., 975.
Middlekauff, G. W., 892.
Miller, F. C., 884.
Millikan, R. A., 943, 946.
Morgan, J. L. R., 854.
Muynck, R. De, 923.
v. Myrbach-Rheinfeld, O., 824.
Nagaoka, H., 954.
Nernst, W., 900.
Nicholson, J. W., 944, 945.
Nordmann, C., 839.
Nutting, P. G., 870.
O'Connor, E., 874.
Parsons, C. A., 909.
Pascal, P., 938.
Peirce, B. O., 930.
Perman, E. P., 974.
Petrenko, G. J., 968.
Petrowsky, A., 925.
Pochettino, A., 881, 926.
Ramsay, W., 957.
Rankine, A. O., 959.
Ratnowsky, S., 921.
Rayleigh, 857.
Reiger, R., 847, 920.
Révillon, L., 820.
Rheinfeld, v. Myrbach-, O., 824.
Richards, T. W., 902.
Roberts, A. W., 840.
Rosa, M. La, 876.
Ross, W. H., 972.
Rossi, P., 860.
Rossi, R., 872.
Rubens, H., 866, 896.
Russ, S., 885.
Russell, A. S., 888.
Rutherford, E., 887.
Sachs, S., 918.
Sackur, O., 906.
Salet, 835.
Sarasin, E., 886.
Schaefer, C., 911.
Schulze, F. A., 912.
Schulze, G., 971.
Schuster, A., 827, 939.
Shaw, H. K., 829.
Siewertsz, N. H., 907.
Smith, J. J., 976.
Snow, E. C., 856.
Soddy, F., 888, 904.
de Sparre, 852.
Stahl, W., 877.
Suchodski, W. A., 855.
Swinton, Campbell-, A. A., 949.
Tammann, G., 819.
Taylor, T. S., 889.
Thompson, S. P., 949.
Thomson, J. J., 895.
Tommasina, T., 886.
Tugman, O., 870.
Unwin, W. C., 845.
Waetzmann, E., 915.
Warth, C., 969.
v. Wesendonk, K., 913.
Whitehead, J. P., 949.
Williams, A. S., 831.
Wilson, W., 891.
Witte, H., 903.
Wood, R. W., 880, 896.
Żorawski, K., 850.